Part I

CHAPTER I

Conference Arrangements

The Background of the Conference

1 Following the Commonwealth Education Conference held at Oxford in 1959, a Conference of Experts from Commonwealth countries on the Teaching of English as a Second Language was held at what was then Makerere College in Uganda in 1961. In view of the success of this Conference the Second Commonwealth Education Conference held in New Delhi in January 1962 considered the question whether, and on what terms, it was desirable to hold conferences of Commonwealth experts on other subjects. The Conference agreed that conferences of experts were a suitable form of Commonwealth co-operation provided the principles and criteria, which it laid down in its report, were met. It further recommended that the Commonwealth Education Liaison Committee should be responsible for considering subjects for further expert conferences, and referred to the Liaison Committee the suggestion that a conference on the teaching of science and mathematics at the secondary level would be of immediate importance to developing countries.

2 These recommendations and suggestions were considered by the Commonwealth Education Liaison Committee which decided to hold in 1963 a Conference of Commonwealth Experts in the Teaching of Science at the Secondary Level. At the invitation of the Government of Ceylon and the Vice-Chancellor of the University of Ceylon, the Conference was held at Peradeniya, Ceylon from 9th to 21st December 1963. The report of this Conference was unanimously adopted by the Third Commonwealth Education Conference held at Ottawa in August/September 1964 and it was commended to Governments for appropriate action when possible.

3 The Third Commonwealth Education Conference concurred fully with the criteria for the holding of conferences of experts as outlined in the report of the Delhi Conference. It added the further criterion that subjects for such conferences should be of clearly defined scope. It then proceeded to recommend that the Commonwealth Education Liaison Committee should give consideration to the holding of conferences of experts on mathematics in schools and on the training of technicians.

4 This recommendation was considered by members of the Liaison Committee early in 1965 and after careful deliberation and consultation with their Governments they agreed that a Commonwealth Conference on the training of technicians be arranged and that it be primarily a conference of specialists in that field. At the same time the Liaison Committee set up an Organising Committee to investigate and make recommendations on such matters as the scope and organisation of the Conference, and thereafter to deal with questions of detailed planning, time, location and finance.

5 Dr. G. E. Watts, C.B.E., Principal of the Brighton College of Technology, was invited to serve as Chairman of the Organising Committee. The Deputy

Director of the Commonwealth Education Liaison Unit, Mr. F. J. E. Ogwuazor and later Mr. L. M. Graham, acted as secretaries to the Committee. The services of Mr. J. M. Scoular of the Ministry of Overseas Development, United Kingdom, were made available on secondment to the Unit for a period of twelve months for the purpose of assisting the Secretary in the administration and organisation of the Conference. The Organising Committee, originally set up, comprised Mr. F. P. Dunnill (Britain), Mr. N. R. Edwards (Australia), Dr. H. W. French (Britain), Mr. H. S. C. Gill (Tanzania), Mr. A. W. Kayper-Mensah (Ghana), and Mr. A. J. Kidwai (India). Mr. H. M. Collins, Mr. J. W. Gailer and Mr. J. C. Jones (Britain) were co-opted onto the Committee during the course of its work, and Mr. S. M. Sepeku replaced Mr. Gill as a result of changes in the staff of the Tanzania High Commission.

6 After further consultation with Governments on their preferences for holding the Conference in a developing or a developed country, it was decided to accept an invitation from the Government of Britain, in association with the Huddersfield Local Education Authority, to hold the Conference in the Huddersfield College of Education (Technical). This College was considered particularly suitable for the Conference as it is one of four in Britain specially equipped for the training of technical teachers. It is located in a heavily industrialised area with easy access to organisations and institutions concerned with the employment as well as the training of technicians in the fields of industry, agriculture and commerce, and can provide very modern residential accommodation.

7 The Commonwealth Education Liaison Committee, inviting Governments to participate in the Conference, stressed the aims of the Conference as follows:

> 'It has become increasingly recognised that there exists, between the skilled craftsman on the one hand and the technologist on the other, an intermediate-level man, generally known in industry as a *technician*, whose contribution to his country's economy is of immense and growing importance.
>
> The primary purpose of this Conference is to enable each participating country of the Commonwealth (irrespective of the stage of economic development it has reached) to secure the maximum possible improvement in its arrangements for educating and training this level of man (or woman). It is hoped to achieve this by:
>
> (*a*) examining the basic needs for technician-level personnel in terms of the general provision of trained manpower in a country; and to consider the steps which might be taken to ensure that these needs are met;
>
> (*b*) reviewing, comparing and contrasting education and training arrangements for technicians in various countries and considering specifically the practical programmes needed for developing countries, with a view to assisting an assessment of what modification or development of existing programmes is needed;
>
> (*c*) considering common problems, such as the provision of accommodation, equipment and teachers, the selection and testing of students, the administration and financing of institutions, etc.;
>
> (*d*) discussing, in specialised working groups, details of the educational and training needs of specific types of technician. (In deciding which groups of technicians shall be dealt with in this way, due regard will be paid to the expressed interests of participating countries);
>
> (*e*) noting the patterns of aid which might best contribute towards these ends.'

8 It was further pointed out that the Conference was intended to be a meeting of specialists directly concerned with technician education, and that it would be advantageous if as many as possible of the delegates were persons who, by reason of their high professional standing or positions of administrative responsibility, are able to influence the development of educational and training programmes in their own countries.

9 It was decided that the main themes of the Conference would be dealt with by inviting recognised experts to present leading papers. Each of these themes could then be discussed in detail by Working Groups, who would prepare a report for a further discussion in plenary session. The lead papers, the reports of the Working Groups, and a short account of the discussion of these reports in plenary session are reproduced in this report. The following lead papers were presented:

(1) 'Manpower background of technician training and the status of technicians': Mr. L. S. Chandrakant, Joint Educational Adviser, Ministry of Education, New Delhi, India.

(2) 'Types, content and organisation (including extension and correspondance courses) of technician education and training for men and women, and its place in education and employment': Dr. H. W. French, Chief Inspector (Further Education), Department of Education and Science, London, England.

(3) 'The planning and equipping of institutions including the provision of libraries, text-books and audio-visual aids': Mr. R. E. Dunbar, Director, Department of Technical Education, Sydney, N.S.W., Australia.

(4) 'The supply and preparation of teachers and ancillary staff': Mr. A. MacLennan, Director, Huddersfield College of Education (Technical), Huddersfield, England.

(5) 'Entrance requirements and selection for technician education and training, and the evaluation and recognition of standards of attainment': Dr. J. T. Young, Principal, Chance Technical College, Warley, England.

(6) 'Administration, finance (including assistance for students), control and inspection': Mr. J. W. Gailer, Assistant Adviser on Technical Education, Ministry of Overseas Development, London, England.

(7 and 8) 'Assessment of the present and planned provision for the education and training of technicians in Commonwealth countries'; Parts I and II: Mr. J. C. Jones, Adviser on Technical Education, Ministry of Overseas Development, London, England.

(9) 'Aid patterns and Commonwealth co-operation': Mr. R. K. A. Gardiner, Executive Secretary, United Nations Economic Commission for Africa, Addis Ababa, Ethiopia.

10 Commonwealth Governments and represented international organisations were requested to contribute supplementary papers on topics relevant to those dealt with in the lead papers or other aspects within the framework of the general theme of the Conference. A list of contributed papers appears in Appendix II of this report.

Participation

11 The Conference was attended by 118 delegates and observers representing 24 Commonwealth countries and British Territories and a number of international organisations. Mr. Arnold Smith, Commonwealth Secretary-General, Mr. A. L. Adu, Deputy Commonwealth Secretary-General, Mr. H. L. Elvin, Chairman of the Commonwealth Education Liaison Committee and Dr. H. W. Springer, Director of the Commonwealth Education Liaison Unit were able to attend part of the Conference. Other visitors included representatives of Commonwealth High Commissions in London. A list of all those attending the Conference is given in Appendix I of this report.

The Conference Programme

12 The Conference was opened on behalf of the host Government by the Right Honourable Anthony Greenwood, M.P., Minister of Housing and Local Government who was introduced by the Chairman of the Conference, Dr. G. E. Watts. A vote of thanks was proposed by Dr. H. W. Springer, Director of the Commonwealth Education Liaison Unit.

13 The programme of the Conference included nine plenary sessions in which the lead papers listed in paragraph 9 were presented. The delegates were divided into Working Groups of two types. Working Groups 'A' were concerned with a detailed consideration of the topics dealt with in lead papers 1 to 6, and Working Groups 'B' with a discussion of the education and training of specific types of technician. The programme was arranged so as to make it possible for delegates to take part in the work of one Working Group in each category. The subjects for discussion in Working Groups 'B' were the education and training of:

Mechanical and electrical engineering technicians;
Agricultural technicians;
Technicians in business and commerce;
Chemical and other science technicians;
Civil engineering and construction technicians;
Technical education and training of special interest to women and girls.

14 A daily bulletin covering the activities of the various Working Groups and a daily timetable kept the delegates informed of progress in the group meetings. Each Working Group prepared a report and these reports were discussed in plenary sessions.

15 A full day in the programme was devoted to an exhibition of audio-visual aids. Material for this exhibition was provided by many firms, technical colleges, and the host college, and delegates were given an excellent opportunity to acquaint themselves with the latest developments in the field of teaching aids.

16 Arrangements were made to enable delegates to visit Bradford Technical College, Huddersfield College of Technology, West Riding Institute of Agriculture, Askham Bryan, near York, and Associated Electrical Industries Limited, Manchester.

17 The closing session of the Conference was addressed by Professor Sir Willis Jackson, F.R.S. and by Mr. Goronwy Roberts, M.P., Minister of State at the Department of Education and Science, London.

18 Throughout the Conference, all those attending were most impressed by the many acts of hospitality and kindness they encountered. Early in the Conference they were received by the Mayor and Mayoress of Huddersfield at a civic dinner held at the Huddersfield College of Technology, the catering for which was undertaken by students of the Catering Department. Delegates were also welcomed at a reception arranged by the British Council. Delegates were invited to visit Nostell Priory where they were received by Lord St. Oswald and shown around his stately home. A concert was held in the School of Music at the Huddersfield College of Technology at which delegates were entertained by the orchestra of the School. Towards the end of the Conference, all participants were entertained at a cocktail party given by the British Government.

Acknowledgments

19 The Commonwealth Education Liaison Committee wishes to place on record its deep gratitude to all those who contributed to the success of the Conference. It is not possible to make specific reference to every person and institution concerned, but a special indebtedness is acknowledged to the British Government, the Huddersfield Education Authority, the Chairman and members of the Organising Committee of the Conference and to the Director of the Huddersfield College of Education (Technical) who spared no effort in making the necessary arrangements for the Conference to be held; to those members of the academic staff of the College who acted as Recorders to the Working Groups, and to the Department of Business Studies of the College for providing assistance in the voluminous typing and duplicating work of the Conference; to those firms and colleges who provided material for the exhibition of audio-visual aids, and to the organiser of the exhibition; to those institutions visited by delegates for the hospitality they provided, and to the domestic and catering staff of the College for their personal interest in the welfare and comfort of the delegates.

20 The Committee is grateful for the support given to the Conference by Commonwealth Governments and international organisations; to the experts who presented stimulating and informative lead papers; and to the delegates who took part in the discussions which led to such a valuable exchange of ideas and information.

CHAPTER II

The Work of the Conference

INTRODUCTION

1 The primary purpose of the Conference was to provide an opportunity for the exchange of ideas and information on the education and training of technicians between specialists from the participating countries: to create a forum within which problems could be identified, different methods of tackling these problems could be put forward, and the advantages and disadvantages of these solutions could be discussed.

2 It is not appropriate for a conference of this sort to pass resolutions or to make specific recommendations for future action nor, in a subject so wide and diverse as the education and training of technicians, is it possible to submit a single set of solutions which would be universally applicable to the many and varied requirements and differing conditions—educational, industrial and social—of the participating countries. Nevertheless, there emerged from the Conference a number of clearly defined themes which reflected a general consensus of view on the problems involved in educating and training technicians, and a considerable measure of agreement on the ways in which these problems should be tackled. It was decided, therefore, that these themes merited specific mention within the framework of a general survey of the work of the Conference.

What is a technician?

3 The Conference quite deliberately rejected the temptation to attach a specific clear-cut meaning to the term 'technician', and accepted the impossibility of finding an acceptable definition which would cover the whole range of industry and commerce. It was recognised that, throughout the whole range of industry and commerce, there is a broad spectrum of occupations lying between the craftsmen, on the one hand, and the professional (or technologist) on the other: within this spectrum there are wide differences, both in subject interests and in degrees of expertise, which must be taken into account when planning educational and training programmes, but the whole band does represent a unique and distinguishable group of people who, whatever their specific functions, can be broadly classified as technicians.

The need for adaptability and breadth of outlook

4 The important part played by this group of intermediate-level personnel—the technicians—in keeping industry and commerce moving was generally recognised by all participants in the Conference as basic to the whole question of providing proper education and training. All countries, whatever the stage of economic development reached, are facing the problem of how to adapt to an ever-increasing rate of technological change and scientific progress: the technician, who combines specialist knowledge, experience and skill with the ability to apply these under the general direction of a technologist, and who has additional responsibilities often of a supervisory nature must, if he is to play his

proper part in the solution of this problem, be himself adaptable, and he needs to have an appreciation of the social and economic environment beyond the narrow confines of his immediate discipline, whether it be technical or commercial. This twin need for flexibility and for a wider outlook was emphasised again and again throughout the Conference, e.g. in the importance attached to broad-based courses which include 'liberal' or humanistic studies, and in the design of colleges and the importance of providing adequate communal and recreational facilities.

The need for collaboration with employers

5 Another outstanding theme which was apparent in all the Conference discussions was the supreme importance of associating industry and commerce—the employers—with the planning and implementation of education and training programmes for technicians. From the initial forecasts of technician manpower requirements through the analysis of job content to the preparation of course syllabuses and the final assessment of competence, there is an urgent need to ensure the closest possible co-operation of employers. The problems of providing proper education and training for technicians are the concern of a partnership between government, employers and the educational system: each has its responsibilities and each must collaborate with the others in a combined effort if the right solutions are to be found and applied.

The status of technicians

6 The recognition of the technician's need for broadly based courses including humanistic studies, and the importance of close collaboration between employers and educational institutions were two of the themes which appeared and re-appeared throughout the Conference: there was a third, which also merits specific mention, since it too was repeatedly emphasised by delegates from all parts of the Commonwealth—the status of the technician. There was unanimous agreement at the Conference that one of the key factors involved in the provision of proper education and training for technicians is the establishment of an understanding and appreciation of the status of the technician, both within industry and commerce, and within society. If the technician is to be accorded the recognition which he deserves, and desires, the public in general, and industry and commerce in particular, must be convinced of his quality and potential use to the community. This question of status, therefore, goes beyond the provision of proper salaries and other outward status symbols, important and necessary as these are. Again and again, delegates were concerned to emphasise the need to give technicians a recognisable career structure, adequately reflecting the importance of their position in the complex of industrial and commercial occupations. The technician is neither a 'failed' professional nor is he an up-graded craftsman. Training and education programmes for all types of technician must reflect this separate identity and the courses must be seen to exist in and for themselves; in words which run through the detailed discussions and detailed reports of the working groups 'technician courses must have their own integrity'.

7 These three themes recur in all the discussions and reports of the Conference, providing a continuity and link between the various sections. They emerged naturally from the lead papers and the discussions which followed on the

broad issues which arise in the education and training of technicians in countries at different stages of economic development. In studying these broad issues, the Conference was concerned with methods of determining the number of technicians needed, the status which they should be accorded, what they should be taught and where the teaching should take place, who should do the teaching, where may the teachers best be found and how should they be trained, how should technicians be selected and assessed after training, who should be responsible for the education and training and how should this be administered. These questions were dealt with in some detail and are considered in Chapters IV to IX of this report. The main points, however, may be summarised here.

THE MANPOWER BACKGROUND

8 The importance of detailed manpower surveys in order to assess the demand for technicians cannot be over-emphasised. This is a matter of common concern to all countries whatever their stage of economic development. Manpower studies, whether made on a national basis or solely within particular industries, remain of a very rough-and-ready nature and frequently provide inadequate forecasts. There is a great shortage of trained people to undertake manpower planning surveys and the related job analyses which are essential if training and education programmes are to be based on reliable information.

9 The employer and, particularly in developing countries, the government as, perhaps, the largest employer of technicians, have a very important part to play not only in establishing the numerical demand for technicians but also in establishing the job requirements so that these may be evaluated in terms of education and training needs.

10 An important factor in producing technician recruits in the right numbers is the recognition of the technician as an important and essential member of industry and commerce. This calls for a salary scale commensurate with his responsibilities and the outward symbols of his real status. Associations of technicians, either alone or as a part of the professional organisations, would be one method of advancing the status of technicians and within these associations technicians would be able clearly to state their own views.

COURSES FOR TECHNICIANS

11 The broad spectrum of technician occupations is necessarily paralleled by an equally broad range of courses, from the near-professional at one extreme to the near-craft course at the other. Wherever a particular course is to be found within this spectrum, it is essential that it should be broadly based, so as to allow for a range of subsequent specialisations, and that it should have its own integrity. A properly planned and integrated technician course will differ, both in content and in approach, from courses planned to meet the requirements of craftsmen on the one hand and technologists on the other; whilst the able student should not be denied the opportunity of transferring to a professional course, the technician course must not be distorted in order to cater for such minority considerations, nor should the technician course form part of a planned progression to professional or technologist studies.

12 Whilst there is a bewildering variety of technician courses throughout the world and many differences in their organisation in various countries, there are certain recognisable basic components. In broad terms, every technician course should comprise those subjects which, taken together, constitute the theory needed for a proper understanding of the techniques to be mastered, together with laboratory and experimental work relating to that theory; technical studies to assist the technician to acquire the necessary skills to do his job; and humanistic studies and general education of which a major part may be concerned with written and oral communication. To this course must be added a training element, concerned with the actual equipment to be used and the techniques to be exercised. A major aim in the preparation of technician courses is to arrange for the careful integration and co-ordination of these various components.

13 The Conference considered a number of organisational patterns with their variations including full-time integrated courses, sandwich courses, block release courses, day release courses, evening courses, correspondence courses, accelerated courses and refresher and upgrading courses. The relative advantages and disadvantages, and the suitability in given situations of all these courses were discussed.

14 Full-time integrated courses have powerful advantages. Integration of the various elements of a course is easier to achieve when they are all dealt with within a college. The purpose of practical work can be instructional rather than geared to production, and this work can be provided irrespective of the availability of employment in local industry. There can, however, be a number of disadvantages. The industrial atmosphere is missing and the practical work conducted in the college may have an air of artificiality about it. Without close collaboration with local firms contact will be lost with the industry for which the course is being conducted. When full-time integrated courses are conducted every effort should be made to simulate, in the practical work, industrial or commercial conditions as closely as possible. This should involve adoption of normal work or office discipline and the observance of normal stores and office procedures. The very nature of this kind of course demands that it should contain a sound content of practical technology.

15 As an alternative to the full-time integrated course, the sandwich course has much to commend it. In this type of course, periods in college alternate with periods in industry or commerce. The student is thus introduced to a genuine industrial or commercial atmosphere and is able to receive technical training on equipment and installations which it may be difficult for the college to provide. It is vitally important to the proper organisation of a sandwich course that there should be very close liaison between industry and commerce on the one hand and the college on the other; care must be taken to overcome the difficulties of correlating the college studies with the industrial or commercial experience.

16 Where the co-operation of employers is forthcoming, block release courses offer a satisfactory alternative to the sandwich course but, again, the difficulties of correlating industrial and college work need to be overcome and close liaison and co-operation between employers and college is essential. Day release courses have a number of satisfactory features although it is arguable that the time

available is insufficient for the amount of theory needed by the technician. Evening courses, although the need for them in certain circumstances may continue, are an unsatisfactory method of educating technicians.

17 There is a need for more research on the relative effectiveness of the different types of course organisation and also on the real length of time required for technician education and training. It was suggested that improved teaching techniques and a proper evaluation of technician requirements might permit a course to be shortened or accelerated, although if this is to be done care should be taken to ensure that speed is not achieved at the sacrifice of standards or quality.

18 Correspondence courses, often linked to periods of block release to a centre for practical work, play a significant and important part in many Commonwealth countries. These are especially important in areas with a scattered population and in subjects for which the demand is likely to be small. The further development of this type of course, bearing in mind its limitations as well as its usefulness, was seen to be a fruitful area for Commonwealth co-operation.

THE PLANNING AND EQUIPPING OF INSTITUTIONS

19 The Conference paid considerable attention to the question of planning and equipping the institutions which are concerned with technician education and training.

20 As far as planning is concerned, two requirements must be stressed. Firstly, as much forward planning as possible should be undertaken and there should be the fullest collaboration between all concerned in the establishment of the institution. Secondly, in the course of planning it is essential that flexibility in design should be the keynote.

21 General guides on planning buildings do exist and recommended norms have been established in some countries. There is a need, however, for further research into the design of buildings and related matters such as the layout of workshops and laboratories. It is essential that local conditions be taken into account in planning institutions and there are grave dangers in adopting patterns established in other countries. It is also important to recognise that the teaching methods to be employed should exert an influence on the design of classrooms, laboratories and workshops. This should be taken into account at the planning stage.

22 The Conference recognised the major part played in the social development of young technicians by communal and recreational facilities. Adequate facilities of this kind must be provided and the utmost care exercised in their design. The need for careful planning of libraries, laboratories, workshops, staff accommodation and storage areas was also emphasised.

THE SUPPLY AND PREPARATION OF TEACHERS

23 In dealing with this topic particular emphasis was laid on the practical problems involved and an attempt was made to suggest practical solutions to them. The problems of technical teacher training are specific. They arise out of specific situations and are not the same as those of general teacher training.

Nor are they the same in all countries. It is necessary to examine the need in each situation as it arises and then to decide the objectives, organisation, content and method of technical teacher training as applied to a specific level and area of technical teaching. There is a real need for job analysis and an analysis of the kind of person required in the field of technical teacher training.

24 The Conference considered the ways in which technical teacher training may be organised with particular reference to methods by which the developed countries can assist the developing countries. In this context it was recognised that one of the main requirements for a technical teacher is industrial or commercial experience at the level at which he teaches and of a quality which will be respected by his students. It may be more difficult for developing countries to provide relevant industrial experience than the other aspects of training, so it is strongly urged that one of the most useful contributions the industrialised countries can make is the provision of facilities for industrial training for teachers from other countries. It was stressed that countries sending students abroad should indicate with some precision the kind of training needed. Receiving institutions are then in a position to provide courses to meet particular stated needs.

25 Considerable concern was expressed at the problem of wastage which arises as technical teachers find better-paid employment in industry. There is a need to establish the extent of this problem in various countries and it was suggested that a survey should be made to find out what technical teachers who had been trained under schemes of co-operation were now doing. To overcome the problem, the technical teacher must be offered a career structure which will be attractive to him and, additionally, industry and commerce must be convinced of the need for technical teachers if future demands for technicians are to be met.

SELECTION AND ASSESSMENT OF TECHNICIANS

26 The selection of potential technicians should be the joint task of employers and colleges so that a young person may be guided into the type of job for which he is most suited in accordance with his abilities and interests, and placed on the type and level of technician course in which he is most likely to succeed. If this task is to be carried out effectively, much more refined placement techniques are essential and there is seen to be an urgent need for additional research into the development and validation of selection tests. Career counselling and guidance services, operated by professionally trained people are also needed and more extensive use should be made of school records, which should be much more detailed and comprehensive than is normal at the present time.

27 Entry to a technician course, with its considerable content of mathematics, science and technology, requires a minimum academic standard approximately equal to the British GCE 'O' level: given the percentage of school-leavers acquiring this standard of secondary education and bearing in mind the competition from other forms of education, it is probable that many, if not most, student technicians will only attain the required standard by following a pre-technician course within the technical education, as opposed to the secondary education, system. This further underlines the importance of adequate selection procedures.

28 The assessment of students on technician courses should be seen as a continuous, purposeful process in which both colleges and industry have a part to play. Existing methods of assessment are frequently narrow and unsuited to technician training. What is needed is effective evaluation of the ability of a student to use the knowledge, skills and understanding he has assimilated during his academic and industrial training on a practical assignment. The closest collaboration between employers and the educational institutions is essential in this process of assessment if wide divergencies of standard, *for the same type of technician*, are to be avoided. Additional research into the validity of different assessing and examining procedures would be valuable; there is also need to clarify the many and varied technician qualifications and to relate them one to another.

ADMINISTRATION, CONTROL, FINANCE AND INSPECTION OF TECHNICIAN EDUCATION

29 Technical education is concerned with the need to increase the numbers of trained personnel required by industry, commerce and agriculture. Technical education is also concerned with the need to produce better citizens, who are able and equipped to play their proper role within society and who must be capable of adapting to the needs of technological advance.

30 Technical education must be seen as an integral part of a country's educational system and it must be given parity of esteem with other forms of higher education. It should be based on a partnership between government, industry and the teaching profession, each working closely with the others in order to ensure that the best use may be made of the manpower and finance available.

31 The methods adopted for the administration and control of technical education vary widely within the Commonwealth, and it is neither possible nor desirable to attempt to lay down a standard system for universal application. The particular form adopted in any given country must depend upon and reflect national and local requirements and circumstances; but whether the system is controlled from the centre, from the state or region, or from the individual teaching institutions, the use of advisory boards or committees is considered necessary in order to provide the essential liaison with, and participation of, industry or commerce.

32 Technician education and training, as part of the general system of technical education, poses a number of specific problems because of the variety of technician occupations, the need for complex and expensive equipment and so on. Educational institutions concerned with technician education and training vary from universities with a 'technician faculty' to polytechnics dealing solely with technician type courses to combined technician and craft colleges offering a range of courses at each level.

33 There can be no clear answer to the question of which type of institution is most suited to carry out technician education. Each solution has its own advantages and disadvantages and a balance must be struck in every case. Some universities, which normally recruit students at the equivalent of 'O' level, may be highly successful in providing an 'umbrella' for technician courses at the middle and advanced level, whereas universities which normally recruit students with advanced level qualifications may find it difficult to adjust to the less academic requirements and disciplines even of high level technician courses. Technical colleges offering a range of craft level and technician level courses may find it difficult to recruit staff of the required standard or to obtain the necessary equipment and laboratory facilities; on the other hand, the association of craft and technician students and teachers may make easier the selection and transfer of the abler craft student to technician courses. In every case, as has been said, a balance must be struck between the various pros and cons in the light of prevailing local and national circumstances: the important thing to be remembered at all times is the integrity of technician courses in themselves.

34 One of the factors which must, of necessity, influence the type of educational institution established for technician education is finance. No country has unlimited resources to spare for technician education and training and it is essential to utilise what is available in the best possible way. This will involve not only a consideration of the capital costs of buildings and equipment but also a recognition of the recurrent costs which will need to be faced over a period of years if the resources devoted to the institution are to be properly and efficiently used.

35 Technician education and training is a costly but essential exercise. It needs to be contrasted with the alternative, which is frequently the use of over-qualified people (graduates and other professionally qualified persons) to perform technician functions: this is a much more expensive and wasteful method of providing for industrial and commercial requirements.

36 The inspection of establishments responsible for technician education and training provides a method of ensuring that value is received for the money spent and that the standards of achievement are satisfactory. This inspection may be organised directly under the government, or it may be arranged on a national or regional level by groups of institutions which would lay down minimum standards of attainment in respect of staff, equipment and so on. Other countries or areas may wish to rely on international bodies, acting in an advisory capacity and providing also an international validity to the qualifications awarded.

REQUIREMENTS FOR SPECIFIC TECHNICIANS

37 In addition to the discussions on these broad issues, which affect the education and training of all kinds of technician, the Conference, through Working Groups and reports to plenary session, considered the specific requirements of technicians in a number of basic occupations. Five Groups were established to report on mechanical and electrical engineering technicians, agricultural technicians, technicians in business and commerce, chemical and other science technicians, civil engineering and construction technicians: a sixth Group considered aspects of technician education and training of special interest to women and girls.

38 The reports of all these Groups, with a brief note on the subsequent discussions in plenary session, are reproduced in Chapter X. It is interesting to note here the common agreement on the need for all these technicians to be

adaptable and the consequent concern with the dangers of too-early specialisation. The ready acceptance of the right of women to be considered for training and education on a par with men is also important, given the enormous demand for trained technicians in all Commonwealth countries, whatever the stage of economic development.

PLANNED AND PRESENT PROVISION FOR TECHNICIAN EDUCATION AND TRAINING IN THE COMMONWEALTH

39 Participating governments were asked to submit detailed information on the provisions which they were making for technician education and training so that these could be summarised and their relevance to present and future needs discussed. Chapter XI deals with this aspect of the Conference.

AID PATTERNS AND COMMONWEALTH CO-OPERATION

40 It was not surprising that, in a conference of experts from the Commonwealth and from international organisations, considerable attention was paid to forms of aid and Commonwealth co-operation. The specific paper and discussion on these topics are reported fully in Chapter XII, but in a very real sense the whole Conference was an exercise in multilateral aid and co-operation; in the exchange of views all countries, whether developing or developed, acquired a new insight into the problems involved in technician education and training.

CONTRIBUTED PAPERS

41 A very large number of delegations submitted background papers on various aspects of the Conference, which contributed much to the general level of the discussions. It is not possible to reprint these papers in the report but a list of their titles is given in Appendix II.

CONCLUSION

42 This review of the work of the Conference indicates the very wide field covered by the discussions. It had been hoped to include some consideration of the particular requirements of food and catering technicians and of textile technicians but in the event this was not possible: nor could proper attention be paid to the problems posed in the training and education of technicians employed in the field of medicine and the medical and veterinary auxiliary services, an area which is of considerable importance throughout the Commonwealth and particularly in some of the developing countries.

43 Nevertheless, in the course of two weeks, the Conference surveyed the whole field of technician education and training. The lead papers, representing the detailed observations of experts on the main problems involved, the critical comments of the Working Groups on these same problems, and on the more specific problems associated with particular types of technician, the rewarding exchange of ideas and information in the constructive discussions between delegates from the Commonwealth countries and from international organisations, together make a significant and important contribution to the study of technician education and training and constitute a comprehensive source of information on a subject which is vital to the development of all countries.

44 Finally, the Conference made one recommendation for consideration by the Commonwealth Education Liaison Committee. It was that, at the earliest possible opportunity, there should be convened a conference of experts to examine, in depth, all aspects of agricultural education and training at all levels. This recommendation reflects the unanimous recognition by all participants of the fundamental importance of agriculture to the individual, to the nation and to the world.

CHAPTER III

Text of the Address by Professor Sir Willis Jackson, F.R.S.

AT THE FINAL PLENARY SESSION OF THE CONFERENCE

Those of you who know me at all well will readily understand when I say how pleased I am that this Conference has been organised by the Commonwealth Education Liaison Committee, because I have held the view for many years that the technician problem was not receiving the attention it deserved, and indeed demanded. I make this remark in relation to the United Kingdom no less than to most, if not all, the Commonwealth countries represented here, and I think it would also apply to many other countries which do not have what I hope and believe to be the good fortune of belonging to this remarkable family of ours—a family which makes so readily possible informal meetings of individuals representative of a great diversity of communities, faced with present and future problems which reflect in varying degrees the state of unbalance which characterises the world situation—

> unbalance in the kinds and abundance of fuel and mineral resources,
> in the availability of water for application to power and irrigation purposes,
> in climatic conditions and in population density,
> in dependence on agriculture and in degree of industrialisation,
> in income per capita and in capital resources,
> in the state of educational development,
> and in the restraints imposed by the traditions, the institutions and social order which have been inherited.

Each country must necessarily evolve its own characteristic approach to the problems with which it is faced, and the one relevant to this Conference is, of course, that of how best to adapt itself to the rapidly changing situation which is resulting in large measure from the progress of science and technology, and how best to take advantage in its own context of the associated possibilities. This diversity affords an excellent basis for discussion and mutual help. Each has much to learn from the others, for our problems are basically the same, and if at this moment in time one is more fortunate and in a better position to help than the others, it is salutary to remember that history records some remarkable changes within the world community. We are therefore wise to search for and to seek to resolve together matters of common concern.

I have had the opportunity of reading the reports of your several Working Groups and have been greatly impressed with their clarity and objectivity as guides to the action to be taken. I hope that my remarks will serve to emphasise usefully some of the points made in these reports.

It is clearly unnecessary for me to dilate on the magnitude and urgency of the difficulties with which the developing countries particularly are faced. This was well brought out in the paper by Mr. L. S. Chandrakant for the first plenary session, and I should like to repeat a few sentences from this paper, which read—

> 'The mere availability of science and technology does not guarantee that the economic development of a country will automatically occur. If science and technology are to contribute to productive processes, special talents must be developed. The people must be trained to apply the knowledge and techniques effectively on a broad front. The availability of people with the necessary skills determines the direction and rate of economic growth in the developing countries.'
>
> 'In brief, the most important investment any country can make, whatever the stage of its economic development, is in its human resources. In the education and training of its population under institutions which create incentives and make it possible for the individual to realise his aspirations—here is the heart of the solution.'

Those wise words reminded me of Sir Arthur Fleming who, some fifty years ago, established the scheme of industrial training for which Metropolitan Vickers became renowned, and of his saying that the most important raw material of industry is its young people. And also of a remark made at an OECD Conference in Paris in late September last, on the utilisation of qualified manpower, that we must come to think of investment in trained manpower and of manpower budgets as no less essential than capital investment and capital budgets.

We in this country have been reminding ourselves continually during recent years of our shortage of professionally qualified manpower, of scientists, technologists and engineers. What we have not done sufficiently is to ask ourselves whether our greater shortage might not perhaps be at the technician level. An important reason for the lack of assessment at this level, at least in terms meaningful to the educational system, was the lack of a clear enough understanding and recognition of the technician function within employment. In his lead paper to the second plenary session, Mr. French presented a very clear description of the tasks which lie between those appropriate to professionally qualified manpower on the one hand, and to the craftsmen and operatives on the other, and of the courses that have been devised to prepare young people for the performance of them. Even in individual specialist fields of scientific, technological and engineering work, and indeed elsewhere, the tasks which fall to the technician cover a very wide range, and in present circumstances of rapid change in the demands of employment they have been subject to a corresponding rapidity of change in respect, particularly, of the types of skill and the level of educational attainment required for their satisfactory exercise. In consequence, the range of desirable technician courses is large and it is not easy to define their individual scope and content to meet the pressures of short-term requirements on the one hand, and the need to develop long-term flexibility and adaptability on the other.

But another difficulty—and my impression is that it is virtually a world-wide one—is that of establishing a situation in which good students are satisfied to participate in these technician courses and content with the qualifications associated with them, taken relative to those associated with professionally qualified manpower. This difficulty has been increased, if not in some measure created, by that of finding teaching staff capable of formulating, and content to organise and conduct, courses appropriate to the needs of the technician, and through their enthusiasm for and devotion to this educational task, to establish for these courses and for the associated awards a distinctive status of their own.

In saying these things I do not lack sympathy for the students and staff concerned. The technician problem is a sociological as well as, if not more than, an educational one. A most gratifying feature of the post-war period has been the growth of the facilities for university education, particularly so within the developing countries, and I am only one of many who have experienced a feeling of both deep satisfaction and of envy at the attractiveness of the new universities of Africa and Asia. But as with most steps forward in human affairs, this growth has not been an unmixed blessing. The prestige attaching to university education, and the sense of personal status associated with the attainment of a degree, have commanded so much Governmental and public attention, and made such demands on available resources, as to distract from the claims of students at other levels of the educational pyramid. In this connection perhaps I may be allowed to repeat what I have said many times during recent years, namely that too little recognition has been given to the fact that no new idea conceived by scientists, technologists or engineers in the research laboratory, the development department or the design office can be transformed into efficient, economic and reliable engineering equipment or productive processes without the supporting contribution of technicians and other technical supporting staff; and that the appropriate education and training of this category of personnel is no less important to the productivity of industry and to the health of the national economy than that of their scientific, technological and engineering colleagues. The mistake has too often been made and, as is evident from your reports, the danger still exists, of devising technician courses in such a way as to suit the preliminary requirements of courses leading to professional qualifications. In consequence, they have often not been related specifically enough to the needs of technician employment, and the associated technician qualifications have sometimes *not* been regarded as important enough in their own right, but rather, when attained, as evidence of a failure to proceed to professional ones.

During recent years many countries have been attempting to forecast their future needs for qualified scientists, technologists and engineers, and to use these forecasts as a guide to the desirable expansion of their systems of university level education. In this country the body responsible for the organisation and interpretation of these attempts was first the Committee on Scientific Manpower, established in 1946; and since 1964 has been the Committee on Manpower Resources for Science and Technology. Since 1956 these committees have conducted, with the assistance of the Ministry of Labour and the Central Statistical Office, triennial surveys aimed at obtaining the maximum evidence from educational institutions and employment of the supply, distribution and forward demand for scientific, technological and engineering manpower. The report on the 1965 triennial survey was published a fortnight ago, and I would like to comment on one aspect of it. This concerns the outcome of the Committee's decision to incorporate in the 1965 survey for the first time a request for data about technicians and other technical supporting manpower.

The reason behind this decision, with which I am sure you will all agree, was that it cannot be possible to make reliable assessments of national requirements for scientists, technologists and engineers in the absence of a parallel assessment at the technician level.

Perhaps the most important, and most difficult, aspect of the study of qualified manpower is that of the manner in which the existing stock of qualified persons is being utilised in employment. This problem has, of course, many facets but the one which directly concerns this Conference is the extent to which the duties being performed by professionally qualified manpower may, with appropriate replanning and the use of modern techniques, be undertaken by less highly qualified people. This involves the kinds of job analysis to which you have made reference—the attempt to relate the skills required in the performance of particular tasks to the necessary educational background and preparation. An important study in this field is now being undertaken by a team led by Professor Moser, of the London School of Economics, within a sample of one hundred firms of the electrical industry.

The process of devolution of responsibility is no doubt a well-established characteristic of the most progressive organisations, and carries the advantage that the qualified persons so relieved move into other fields of creative effort with similar later consequences. To be effective, however, the process requires the availability of staff, themselves well educated and trained to an appropriate level, to whom relevant projects can be delegated.

The 1965 manpower survey revealed that in the sectors of employment covered the total number of persons performing functions which conformed to the description of technicians and other technical supporting staff incorporated in the questionnaire was about 622,000 compared with some 211,000 scientists, technologists and engineers employed in the same sectors (the total national stock of scientists, technologists and engineers was 313,000). Of these 622,000, nearly 400,000 were employed in manufacturing industry; 72,000 in the nationalised industries and public corporations; 61,000 in central Government; 21,000 in local Government; and 12,500 in the universities and establishments of further education.

As against the overall ratio of about 3 to 1 between technicians and professionally qualified manpower, the ratio varies considerably between these major sectors of employment and, as shown in the table, between the different branches of manufacturing industry. It will be seen that in the universities and establishments of higher education the ratio is of the order of 1 to 1, and that in the motor vehicle and construction industries it rises to over 6 to 1. Although no absolutely clear distinction can be drawn it would seem that the more scientifically based the industry, as illustrated by the mineral oil refining, chemical and electronics industries, the smaller the ratio of technicians to professionally qualified manpower. No figure is given for the schools, which employ over 27,000 scientists, technologists and engineers but very few technicians as described in the survey. I hesitate to comment on these ratios in relation to the developing countries, but cannot help feeling that they suggest a marked change in emphasis, in some cases, in educational planning. Clearly, however, there is no magic figure which is universally applicable.

Ratios of Technicians to Professionally Qualified Manpower
In Different Sections of Employment in the United Kingdom
1965

1. *Universities and Higher Education*	roughly 1 : 1
2. *Industry*	
Food, drink, tobacco, etc.	2·8 : 1
Chemicals and Allied Industries	1·8 : 1
Mineral Oil Refining	1·1 : 1
Metal Manufacture	3·8 : 1
Mechanical Engineering	5·5 : 1
Electrical Engineering	3·9 : 1
Electronics	3·4 : 1
Motor vehicles	6·5 : 1
Aircraft	6·0 : 1
Textiles	5·4 : 1
Other manufactures	4·7 : 1
Construction	6·5 : 1
Nationalised Industries and Public Corporations	3·7 : 1
3. *Government*	
Central Government	3·5 : 1
Atomic Energy Authority	1·4 : 1
Local Government	2·2 : 1

When the 622,000 were sub-divided in terms of educational qualifications, some 24,000 (4 per cent) were qualified scientists, technologists or engineers; 81,000 (13 per cent) held a Higher, and 87,000 (14 per cent) an Ordinary, National Diploma or Certificate; 56,000 (9 per cent) had obtained a City & Guilds of London Institute Technicians Certificate or the equivalent; and about 60 per cent had none of these qualifications. The first and last of these latter figures are of special significance.

The statement by employers that some 24,000 persons qualified as scientists, technologists or engineers are performing technician, rather than professional, functions may be taken as evidence that at the top level the work and responsibilities attaching to these functions overlap considerably, but it may then mean that a shortage of sufficiently well qualified technicians—qualified, that is, specifically for technician purposes—is necessitating the employment of more highly qualified manpower for these purposes. This reveals an inevitable consequence of shortage and shows that an unbalance in the stock and in the annual production of technically and professionally qualified manpower can mean the employment of the latter on work for which they are not best fitted educationally and are likely to be psychologically unprepared, and which will most probably leave them intellectually dissatisfied.

The fact that 60 per cent of those recognised by employers as performing technician functions possess no technical qualification is evidence that this manpower group has been fed largely from the ranks of the craftsman and operative without any systematic educational preparation for its new responsibilities. It is true that in many of these cases practical experience acquired over a long period combined with good intelligence and personal qualities will suffice. Nevertheless new skills and improved technical knowledge and understanding are being called for increasingly, and it cannot be questioned that these must be acquired by a much larger proportion of the technical supporting staff of the future.

These data raise a further important issue. I have already mentioned, and you yourselves have emphasised, that the technician problem is a sociological as well as an educational one. The 622,000 technical supporting staff detailed above contain 81,000 who hold Higher National Diplomas and Certificates. In my own field of electrical engineering these men have made clear that they are not satisfied to be designated as technicians, and have demanded a symbol of status more consistent with the importance of the contribution and the degree of responsibility they are carrying. This led some two years ago to the establishment of the Institution of Electrical and Electronic Technician Engineers, in close association with the Institution of Electrical Engineers, and with the Higher National Certificate defining the standard of educational qualification required for corporate membership. This was an important step towards the creation of a range of corporate bodies to cater for the interests of technical supporting staff in the various specialist spheres of their activities, and to which they will feel proud and satisfied to belong.

In respect of this important question of status and self-esteem I was extremely interested in the report of your Working Party A(3) on the planning and equipping of institutions for the education of technicians, and reminded of the report of a Committee set up some three years ago by the Government of Northern Ireland under the Chairmanship of the late Sir John Lockwood to advise on the future development of Higher Education in Northern Ireland.

This Committee, of which Sir Peter Venables and I were privileged to be members, recommended the establishment of a second university but also, and in my view more important, the bringing together on a common site for *non-degree purposes* of Colleges of Technology, Art, Music, Domestic Science, Commerce, Physical Training and Technical Teacher Training. What we had in mind was the creation of a community of related institutions at the 'technician' level analogous to a multi-faculty university using common residential, library, athletic and other facilities. We called the whole the Ulster College, in which each constituent college would have its own Principal and Advisory Body, but with the whole co-ordinated for common purposes through a suitably constituted Council.

I am pleased to say that the Government of Northern Ireland accepted the recommendation, has acquired a 120-acre site for the purpose, and the first buildings on it will be those of a new College of Technology. The Queen's University in Belfast is to be an active participant in the scheme and has agreed to devise all practicable means of arranging for the transfer of selected students from the College to degree courses at the University.

I must not pretend that there will not be difficulties—in particular that there are not already degree awarding ambitions within some of the constituent colleges—but the aim is to create another kind of community of staff and of students with a different educational objective from that of the university, and a different kind of status within the community.

The present scale of the United Kingdom educational provision for technical supporting staff is not easy to quantify, but the annual output of those with nationally recognised qualifications in this field is now around 40,000—nearly twice that of scientists, technologists and engineers, though the total stock of technical supporting staff is some three times as large as of the latter. The main limitation at present appears to lie in the number of suitable students, not of suitable courses.

The resolution of the problems I have mentioned will demand a much closer partnership between employment and education than has yet been achieved in my country. The word 'partnership' is crucial. I intend it as a stronger word than 'collaboration', for my concept of partnership is that each of the partners shall interest itself in and, where appropriate, make a contribution towards, the work of the other, as well as fulfilling the responsibilities which fall to it directly within its own domain. This means that employers must participate in the formulation of the classroom and laboratory content of college courses and accept joint responsibility for ensuring the proper integration of these courses with the pattern and sequence of practical training. And, of course, there must be provision within employment of good facilities for systematic training under the supervision of training officers and workshop instructors. There must indeed be a growing recognition by employers that, so far at least as their new recruits are concerned, the domain of employment is as much a part of the educational system as are the colleges of further education, and that only through a close partnership between the two will there be produced a body of young people adequately prepared for satisfactory and satisfying participation in the rapidly changing pattern and circumstances of employment. Moreover, there will be required by many, a periodic re-adaptation to the needs of this changing situation, involving processes of re-education and re-training which will make new demands on employers, since they only will be in a position to specify, and to provide, as part-time teachers, men intimately enough acquainted with what is required. I am convinced that we must cease to regard the attainment of a qualification at age 20–21, whether it be a degree or a technician diploma or certificate, as the terminal point of the educational process—but rather as the end of an important phase in a continuing process of education extending throughout a career. The Industrial Training Boards set up in this country to implement the Industrial Training Act carry a heavy responsibility in these several respects.

It is evident from your reports that a major topic of discussion during the past fortnight has been that of the supply and training of technical teachers, and that this must be a major anxiety in the attainment of your future objectives. But if I may stress once again the necessity for close partnership between the domains of education and of employment, the supply and training of industrial training officers and instructors is likely to be of no less importance. We in this country cannot claim to be much beyond the embryonic stage in this connection, but under the stimulation of the Industrial Training Boards a number of short courses have been established and may be expected to develop considerably during the next few years.

It will be evident to all of you, however, that the effectiveness of training within industry can be assured only if the training officer is supported enthusiastically by the mature employees with whom the young people in training, and in the early years of more responsible employment, will be associated. There were occasions during my periods in industry when I was surprised and disappointed by the rapidity with which men forgot the difficulties and frustrations of their own training and failed to appreciate—or if they did appreciate, showed a singular unwillingness to alleviate—the frustrations of their young successors. I realise, of course, that men occupying responsible positions, whether at the professional, technician or craft levels, have a big enough job to do and that they do not, in general, consider themselves as educators. And yet they have, in fact, a very important educational part to play—that of helping to transform the raw recruits to their sphere of employment into worthy successors, and in more than a purely technical sense. Too few, I have found, seek deliberately and systematically to teach the newcomers what they themselves have learned, as a contribution to this end. It is therefore of great importance that the processes of technical education should stimulate an awareness of, and a sense of responsibility towards, the human as well as the technical considerations in employment which, when properly combined, ensure a satisfactory and satisfying environment and career.

Perhaps the heaviest, and certainly the most difficult, responsibility which falls to those involved in education is to help the coming generations of young people to a clearer concept than my generation has had of the kind of community they should seek to create with the help of the immense potentialities of science and technology.

Part II

CHAPTER IV

Manpower Background of Technician Training and the Status of Technicians

Lead paper presented by Mr. L.S. Chandrakant, Joint Educational Adviser to the Government of India and Joint Director, National Council of Educational Research and Training, New Delhi, India.

1 History in the 20th Century will record as specially worthy of note the fact that after World War II a number of countries, particularly in Asia and Africa that had been under foreign colonial rule for centuries, emerged as independent, sovereign states free to guide their own destinies. As many as sixty such countries are free today, each with its own political and economic ideology, form and structure of government, and with its own social and cultural heritage. The size of the Commonwealth family has increased to twenty-seven members. Equally remarkable is the fact that differences in political, social and economic ideologies notwithstanding, all these emerging countries are now engaged in a stupendous endeavour, unknown in the past ages of man, to reconstruct their national economies to assure the millions of their own people of more and better food, more and better housing, more and better education and health. On the accomplishment of this endeavour depends not only the salvation of these people, but the security and progress of the world. This today is what is at stake.

2 Take India. After more than 190 years of colonial rule, the country attained independence in 1947. Since then, the main concern of the Indian people and their Government has been rapidly to develop the country's economy and improve its standard of living. This concern is reflected in successive five-year plans that have been implemented since 1950. The third five-year plan has been completed; the fourth plan has just begun. The strategy for development is long range; it visualises a 25–30 year period of intensive development. During that period, the national economy should be capable of sustaining an annual compounded growth rate of about 6 per cent without foreign aid. Employment opportunities should increase and a new social order should be established in which there is equality of opportunity and no disparity between income and wealth. To achieve these objectives and solve the basic economic problems of India, the national plans visualise a doubling of the national income, from about 160 billion rupees (£8 billion) to over 370 billion rupees (£18 billion), in the next decade.

3 India is basically an agricultural country. Over 60 per cent of her 480 million people live on and by the land. The land was theirs before they were the land's. The available cultivable land, however, is limited and agricultural productivity low. Therefore, while every effort must be made to increase agricultural productivity, we must shift the basic economy of the country to industry. At the same time, we must build a large infrastructure, able to sustain an industrial economy, by developing transport and communications, electrical power, distribution services, foreign trade and so on.

4 Increase in agricultural productivity demands a strictly scientific approach. More fertiliser, better seed, irrigational facilities, diversification of crops, plant protection and storage are all needed on a sub-continental scale. To meet these needs we must set up a technological base and reorientate the country's agricultural system. Even with these needs fulfilled, the agricultural sector of our economy is not likely to exceed a growth rate of 3-4 per cent. This implies a big leap forward in the industrial sector to reach at least an 11–12 per cent growth rate, by accelerating the development of metallurgical, chemical, fuel, machine-building and other key industries. The industrial sector must account for more than two-thirds of the total increase in the national income of 360 billion rupees.

5 The general strategy of the economic development of India applies equally to other developing countries in Asia and Africa. All of them share the same deeply rooted economic and social problems—low levels of productivity, income and living, a high proportion of population dependent on agriculture, large-scale unemployment or underemployment, dependence on more advanced countries for capital equipment and know-bow, an inadequate rate of economic growth. In some of these countries the problem is intensified by a high birth rate that offsets the small economic growth rate that has been achieved. For instance, while the economic growth rate in India is at present less than 4 per cent the population is growing at the rate of nearly 3 per cent per year. A high economic growth rate can confer benefits and improve living standards only if the population increase is drastically checked. This demands not merely a massive economic effort, but a social discipline as yet unknown to history in such countries.

6 It is axiomatic in economic planning for developing countries that science and technology should play a decisive role in increasing agricultural and industrial productivity. This is the more so, because Time is our enemy. We must do in a few decades what it has taken several centuries to achieve in the developed countries. The mere availability of science and technology does not guarantee that the economic development of a country will automatically occur. If science and technology are to contribute to productive processes, special talents must be developed. The people must be trained to apply the knowledge and techniques effectively on a broad front. The availability of people with the necessary skills determines the direction and rate of economic growth in developing countries. In the last analysis it will be the ambitions and know-how of the people of developing countries that will determine whether minerals stay underground or are transformed into goods useful to man; whether oil remains hidden or becomes a major source of power and heat; whether roads remain mud-tracks or are transformed into arteries of trade and commerce; whether schools and colleges exist for the young, and comfort for the old.

7 In brief, the most important investment any country can make, whatever its stage of economic development, is in its human resources. In the education and training of its population in institutions which create incentives and make it possible for the individual to realise his aspirations—here is the heart of the solution.

8 Our planners are apt to overemphasize the importance of material inputs and capital formation for economic development. There is no doubt that the creation of irrigation, power, transport, mining capacity, coal, steel, fertilisers

and machine-building capacity are all necessary pre-requisites to economic development. But by themselves they do not constitute a necessary or sufficient condition of economic growth. These instruments of production should be effectively utilised by the people. To that end the people must be trained and motivated. We must strive for the maximum output of goods and services from the available developmental facilities and material inputs through a greater response ratio of the human factor. The only indisputable investment is MAN.

9 Manpower planning is broad-spectrum business. At one end of the spectrum is the need to secure 100 per cent literacy in the population, especially for adults who constitute the bulk of the human material engaged in productive activity. Literacy here does not mean merely the ability to read and write. To aid development it must cover functional literacy, to motivate the adult for self-improvement and economic betterment. In India today only 28 per cent of the people are literate. The large mass of the people engaged in diverse fields, like agriculture, industry, trade and transport are illiterate; their productivity is low. Little purpose is served by increasing physical and financial inputs for these fields if the people engaged in them are not educated and trained to make the best use of the inputs. We know how important it is to increase agricultural productivity in all developing countries by providing more fertiliser, better seed, efficient implements, more irrigational facilities, by extending scientific methods of cultivation, crop protection and grain storage. Our national plans provide for a big investment in all modern agriculture operations; but the investment will not yield the best results if our farmers remain illiterate, wedded to primitive methods of cultivation and to a paternalistic type of rural economy. They must be educated and trained to use modern scientific methods and techniques and transform their occupation into a technological enterprise. To revitalise rural economy we must set up agriculture-based industries by training rural youth in this field.

10 Similarly, a large number of our people are engaged in industrial occupations in big and small factories, construction works, power generation, communication systems, transport organisation and in a host of other enterprises, as skilled and semi-skilled workers, artisans, craftsmen operatives. Many of them are practically illiterate; they learnt their trades or skills from their fathers or on the job. As the industrial development of a country progresses and modern technology is introduced, all these industrial workers should be made functionally literate. More, they should be retrained in the use of modern tools and machines, modern methods and techniques of production and construction. As a fresh labour force is needed, skilled workers must be educated and competently trained in their trades. Their industrial skills should be supported by an educational base that helps them to understand the fundamental scientific and engineering principles and apply them to modern industrial production and construction. Many of these skilled workers will rise to supervisory positions like foremen, where they will control and guide workers under them, interpret the plans given them by engineers in terms of shop floor practices such as the setting of tools and machines, and perform a host of other functions that demand trade skills, and, further, a surer understanding of engineering principles. With advancing technology both the skilled worker and foreman should be capable of adapting himself to changing techniques and methods, with conscious intelligence.

11 All developing countries have reached a stage when they need well educated and competently trained skilled workers in large numbers. Skilled workers are needed for practically every industrial complex that is being set up under economic development plans, like the machine tool industry, heavy machinery building, electrical and electronic industry, chemical industry, iron and steel industry, construction industry and so on. For the Indian fourth Five-Year Plan alone over one million skilled workers are needed. For the fifth Plan, the estimate is over two millions.

12 A most important aspect of manpower planning is therefore to estimate the demand for skilled workers, artisans and craftsmen on a continuing basis, to determine the main trades in which they are needed, the levels of professional competency or the trade skill that they should possess, and their distribution over time. Further, the types and standards of training needed to produce skilled workers must be identified. On the basis of the data thus obtained we must design a coherent programme of general education-cum-technical training for producing the skilled workers needed. Advance planning on these lines is the essence of manpower development.

13 Two specific points on training programmes. The first is in regard to the duration of training. All training programmes need not necessarily be full-time courses spread over a long period, nor need they aim at imparting the total skill for a particular level of professional employment. Many required skills can be acquired on the job while a man or woman is in employment. Moreover, skills acquired through primary training programmes become outmoded and need to be renewed and brought up to date. Manpower training programmes therefore must include part-time courses, sandwich courses, refresher courses, orientation courses and in-service training. The other point is that specialisation has its own dangers. While specialised training is undoubtedly necessary to produce the different types and grades of skills needed for industrial development, the present advances in science and technology demand not specialisation only, but integration. Programmes of full educational training must stress a strong base of fundamental knowledge, particularly in science, mathematics and languages to enable the future industrial worker to adapt himself to changing technology and continuously to improve his professional competence in the chosen field of his experience.

14 At the other end of the manpower spectrum, all developing countries need engineers, technologists, research scientists, business and industrial managers and other kinds of highly qualified specialists. They are needed to adapt or adopt known technology to industrial development programmes, engage in research, develop indigenous technology, design and construct industrial plants and machinery, power systems and public utility services, to establish and manage industrial enterprises, and for a host of other activities. These specialist technical, professional and administrative personnel who are at the apex of the manpower pyramid, are the products of a well-designed system of higher education that must function in precise relationship with the economic and cultural life of a country. Any major divergence between a country's system of higher education and its economic and cultural needs leads to chaos.

15 An over-production of graduates destroys the source of the usefulness of universities. We have to be clear about the essential functions of a university in national planning. Equally dangerous is a situation in which development programmes, howsoever well conceived and supported by material and financial inputs, flounder on the bedrock of the lack or shortage of personnel needed to implement them. A correct balance must be established between the scope and size of university education in a developing country and its need for graduates. The accent must be on usefulness and dovetailing with the requirements of the economy. The graduate must be useful; and his usefulness must be relevant. His services should be in demand and should command reasonable remuneration. If the graduate is frustrated when he leaves the portals of a university, the nation at large finds that it has made an unproductive or low-productive investment when it spends a valuable part of its meagre resources on higher education. The last case is worse than the first. How far are our universities regulating their admissions, fashioning their syllabuses and curricula, organising their research work to meet the needs of the economy, preparing their graduates for employment that will make use of their academic training and at the same time affording them satisfaction in their work and reasonable salaries for performing it? These are some of the important questions that all countries, developed or developing, must constantly ask themselves in reviewing the working of their higher education systems.

16 In all developing countries there is a tremendous drive towards universal compulsory education to banish illiteracy and give their people a place in the market. As elementary education expands, pressure builds up for more facilities for secondary education and, further, for university education. As the enrolment of students increases at each stage of education, demand grows for more and more institutions at the next higher stage. Unless this educational spiral is controlled and related to the basic economic and social needs of a country a serious imbalance sets in to defeat the purpose of planned development. For instance, in India today, enrolments are increasing at a terrific rate at all stages of education. Our Constitution demands that the State shall make every endeavour to provide free compulsory education for all children up to the age of 14. Since 1950 the enrolment at the primary stage has leaped from 14 million to over 37 million, and this represents nearly 70 per cent of the relevant age-group. At the middle and secondary school stages, the increase is from 5 million to over 20 million. At the university stage the enrolment has shot up from 44,000 to over 2 million. At this rate of expansion, we may expect that by 1980 the enrolment at secondary school stage will exceed 22 million or 40 per cent of the relevant age-group. At that time at least 3 million students will complete secondary education each year and seek admission to universities. This is explosive expansion with a vengeance! If it is to be prevented from menacing our national life two important measures are necessary, both of which are intimately connected with manpower planning. The first: to restrict admissions to universities to those who possess the necessary abilities and can profit by higher education. Education at this stage should be highly selective and the pursuit of excellence should be its chief aim. The second: to ensure that for the majority of students secondary education is terminal in character (not college preparatory) and equips them with marketable skills for gainful employment in life—in industry, commerce, agriculture and so on. Unfortunately, although secondary education has been expanded on a big scale in India in the last fifteen years and nearly 8 million students are enrolled in our secondary schools, less than 12 per cent of these students are studying in technical or vocational courses. The rest, i.e. 88 per cent or more, study purely 'academic' types of courses that are mainly college-preparatory. This situation hardly reflects the true nature of a developing or developed country. In contrast, in countries like Germany or Japan the proportion of students in schools of general education is less than 40 per cent. It is, therefore, imperative for India, as for other developing countries with similar problems, to develop a system of technical vocational education at the secondary stage to which a majority of students can be diverted after elementary education (i.e. after seven or eight years of schooling) and trained for gainful occupations in life. The new system of technical vocational education should be closely related to the manpower needs of the country in industry, commerce, agriculture and other areas of economic development.

17 An important point to be stressed in this context is that the future skilled labour force should be trained designedly through this system of secondary technical education. The curricular offerings of technical schools must therefore have the following goals:

(*a*) The students should be equipped with a minimum of skills and competences in particular engineering trades of their choice that are marketable in industry or commerce and can fit them to specific jobs at the level of skilled workers after in-plant training or apprenticeship wherever necessary.

(*b*) The students admitted to the courses at the age of 13/14 are still adolescents. Their need for further formal education should be met within the overall framework of the courses. An educational base is necessary for the future development of these skilled workers and their professional advancement to supervisory positions.

(*c*) Modern technology is advancing rapidly and demands trained manpower that is responsive to technological changes and innovations. The system of technical education and training, therefore, should aim at a surer understanding of the basic scientific and engineering principles by the students. It should mould their attitudes and skills for creative life in a developing technological society.

These goals demand an integrated curriculum of general education, technical education and industrial training. All three components should support one another towards the total development of youth for industrial occupations in later life.

18 In planning for university education it is not enough to restrict admissions. It is equally important in relation to manpower needs to achieve a balanced development of all disciplines and subject-fields—the humanities and social sciences, basic sciences, engineering and technology, medicine, agriculture and other professional studies. The number of places in these subject-fields, annual admissions and student-enrolments must reflect a planned approach to the manpower problems of the country. The need for such an approach is underscored

by a comparison shown below of the faculty-wise distribution of student enrolments in India, USSR, Japan and the United Kingdom:

Distribution of student-enrolment (per cent)

Faculty	*India*	*USSR*	*Japan*	*United Kingdom*
Humanities	51·8	Negligible	15·0	30·7
Education	2·3	32·4	11·0	2·0
Fine Arts	0·4	0·8	1·6	0·2
Law	2·7	6·8	10·2	3·6
Social Sciences	7·6	6·4	34·3	5·9
Natural Sciences	26·2	38·8[1]	4·2	21·7
Engineering	3·4		18·1	9·6
Medicine	4·1	8·2	6·0	15·6
Agriculture	1·2	11·5	4·4	2·1

[1] The figures for USSR for engineering seem also to include those for natural sciences.

19 The anomalous position in which a developing country like India finds herself today is borne out by this comparison. When the crying need is for more teachers, more than half of our two million students in universities are studying the humanities. True, our universities are not wholly to blame for this. Universities are not in charge of the economy, nor can they be expected to find out on their own the manpower needs or projections in terms of detailed categories. Nor is it easy to break away from traditions established during foreign rule and at a time when numbers were few, expenditure on higher education small, and anything like a rapid economic growth was outside the pale of practical politics or economics. But, it should be possible now for the universities to take account of the economic reality around them and strive to fit in with its planned improvement.

20 Between engineers, scientists and managers at one end of the manpower spectrum and, at the other end, skilled workers and operatives, there is a group of technical personnel that merits special attention for the particular role that it plays. This group comprising many job or position titles, like technician, supervisor, foreman, overseer, section officer, technical assistant, shift-in-charge and so on, is directly responsible for the application of known technology to a wide-range of field operations in production and construction; testing and development; installing and running engineering plant; drafting and designing products; estimating costs; selling and advising customers on the use of engineering or scientific equipment. In many instances, the technician serves as a liaison between the engineer and skilled craftsman to interpret the engineer's plans and designs, determine the type of production and construction techniques to be adopted and choose the tools and machines best suited to particular jobs. A host of other semi-professional functions of an engineering or scientific nature are identified with the technician who carries them out largely upon his own initiative and under only the general supervision of a professional engineer or scientist.

21 The importance of technicians, particularly to a developing country cannot be over-emphasised. In the short-run, critical shortages in respect of engineers and scientists can be met by adopting or adapting technological know-how from

developed countries and importing the capital equipment needed by industry. A shortage of technicians cannot, however, be made good by these methods because the imported technology and capital equipment can be used by the people of the developing country only when they are adequately trained for the purpose. It is imperative for all developing countries to train and develop their own indigenous personnel as competent technicians. In the final analysis the pace and direction of the economic progress of developing countries will largely depend upon how far they solve their technician problem.

22 These considerations demand that all developing countries must evolve a coherent system of technical education designed to train the technicians and other types of middle level personnel needed by them. In planning for this, however, we must remember that the training of a technician and his professional development is not a course but a long process that takes place partly in a technical institute and partly in industry. The purpose of the technical institute curriculum is to give the future technician a sound, broad-based theoretical knowledge of a chosen engineering field that helps him to understand the basic principles underlying design, construction, or production processes and communicate his ideas scientifically, mathematically and linguistically. The curriculum must mould and develop the attitudes and aptitudes of the student toward optimum proficiency and productive capacity for immediate employment. The education given in a technical institute according to this curriculum must be cross-fertilised with actual practical experience in industry to expose the technician-trainee to actual working methods, techniques and skills relevant to his field of speciality, in drafting, design and development of products and engineering plant; in installing and operating equipment; in construction; in estimating costs etc. In addition, the trainee should be made to observe and understand how the engineering principles and their applications are translated into practical operations and processes in the design office, on the shop floor and in the field. In this process he should acquire sufficient occupational competence to be able to perform the same professional functions independently, when he is employed on the job.

23 To co-ordinate theory with practice, to relate teaching to work in industry and to elaborate the complementary functions of technical institutes and industry—this is the heart of the problem of technician training. A constant concern of all developing countries in relation to manpower planning should be how to develop a vigorous system of technical education to meet their manpower needs, that articulates the joint and co-operative effort of technical institutes and industry. A purposeful system of industrial apprenticeship that, on the one hand, industry accepts as its primary responsibility and, on the other, technical institutes regard as an integral part of the total process of education is our primary need today.

24 The development of a curriculum for technician training is not a mere academic exercise. It takes in a number of important practical aspects like the present status of technology in a country and its future needs, the precise functions of a technician within the overall social and economic structure of industry, the pattern of manpower-employment in each type of industry and relationship between engineers, technicians and skilled workers, the level of technical professional competences demanded of them, and the position of technical education within the country's educational system. These are among

the factors that determine the manpower spectrum of a country and so the curriculum for technician training reflects the sum-total of all the aspects of the manpower situation in a developing economy. While the manpower situation determined by these factors may vary from one country to another, two aspects stand out as of equal significance to all countries. The first: under the impact of scientific advance, the engineering field has exploded and the tasks of an engineer are becoming more and more complicated. The engineer is being increasingly called upon to carry his field of work farther and farther away from the realms of application and operation in which modern engineering started. As a corollary we must train and supply technically competent manpower needed for this engineering application and operation, and augment and supplement the professional engineer and scientist in research, design, development and supervision. This manpower-technician, as we call him, is taking the place of 'the engineer' as we have known him, as 'the engineer' of today and tomorrow increasingly takes his new place and becomes more and more concerned with the scientific problems and opportunities of the expanding technological universe.

25 The second significant point: for his optimum development, the technician is best served by an educational programme that is intimately related to, but that differs from the programme most effective for the engineer, and that likewise differs from the educational programme most effective in developing or enhancing the skills and 'know-how' of the craftsman. The engineering technician does not need the depth or the range of mathematical or scientific understanding required by the engineer. What the technician does need is to have the same subject matter with appropriate communication skills and mathematical competence. To achieve the necessary results, an educational approach is required that is comparable in quality and general level with the university-collegiate engineering programme, but that differs from it in emphasis; for it implies the practical application of established scientific principles rather than the development of new design concepts or the extension of existing knowledge.

26 These two aspects have a direct and important bearing on the need to establish a correct functional relationship between engineers and technicians, and improve the status of technicians. For the optimum use of their talents and professional training, we must move engineers to positions of creative responsibility for research, discovery of new materials and processes and development of new engineering designs. We must increasingly make use of technicians for those tasks that were formerly the realm of engineers. We must open up for them new opportunities of professional advancement. For positive uncompromised results, the training of a technician must be founded in an educational approach totally different from, and more academically vigorous and technical than the skill-proficiency programme designed for the training of the craftsman and commonly represented by the vocational-trade or vocational-technical programmes. It must lie much closer to professional levels of engineering than to the trade-skill and craft level of vocational education. Only then, shall we be in a position to counter effectively the familiar argument that the technician training course is the natural 'dumping ground' for those who 'can't make the grade' in the university-college type of engineering programme. These inter-related fields of human endeavour are equal in their importance to the whole social, economic and professional structure. They, the people in them, and the people who should be in them, to provide the effective and satisfying

balance of manpower distribution needed for our way of life, deserve to be accorded inter-related status and recognition.

27 India is a test case. Since Independence and particularly in the last 10–12 years we have expanded technical education on a big scale. In 1947 there were only 38 degree-awarding colleges producing about 1,270 graduates; and 58 diploma-awarding polytechnics producing 1,440 technicians. Today, the number of colleges has jumped to 133 and polytechnics to 274. The output of graduate-engineers has increased to 10,300 and that of diploma-technicians to 17,700. This big expansion notwithstanding, the proportion of engineers and technicians trained by our institutions has not undergone any drastic change. In 1947, the proportion was almost equal and today it is just 1 : 1·7. We know now that there is a serious imbalance in our technical education system. Also, that we are under-utilising our graduate engineers in positions that could well be filled by properly trained technicians. In fact, according to a study carried out recently in some of our important engineering organisations, nearly 40 per cent of the technical positions at several levels of executive and supervisory responsibility are filled by graduate-engineers, whereas for those positions technicians would be adequate. Undoubtedly, in the initial stages of economic development of the country, when we had to depend on technology adapted from advanced countries and imported 'know-how' and capital equipment, our engineers were assigned those professional tasks that were carried out by technicians in advanced countries. Now that we have reached a stage when we should create our own indigenous technology and be self-reliant, we should utilise our engineers more effectively in those positions of higher scientific and professional responsibility for which they are best suited and increasingly replace them by technicians at other levels. We have therefore decided that in the fourth Five-Year Plan that has just started, the output of graduate-engineers should be pegged down and that of technicians gradually pegged up to reach a proportion of one engineer to three or four technicians. This decision demands that our polytechnic diploma courses should be thoroughly reorganised and up-graded, and also adapted functionally to the duties and responsibilities of a technician.

28 A perspective plan for manpower involves two concurrent steps. The first: to identify the main subject-fields of engineering in which engineers, technicians and skilled workers are needed for our development programmes. The second: to make a quantitative estimate of the demand for personnel over a specified period. Since the supply of personnel must be in step with the demand, it is imperative for all developing countries to co-ordinate their manpower plans with programmes of expansion of technical education. The need for such co-ordination is under-scored by the fact that it takes at least five years to train a competent engineer or technician and practically double that time to establish and fully equip a technical institute. Expansion of technical education must be undertaken far ahead of economic development programmes to ensure an adequate supply of trained manpower at the time at which they are needed.

29 An activity analysis of major job titles or positions in different industrial sectors or engineering enterprises must be made to identify the main subject-fields in which technical personnel are needed. The activity analysis must establish in depth and scope the precise nature of technical professional knowledge needed for different job titles and the supporting mathematical and scientific foundation.

It must also correlate the job titles with different levels of managerial, supervisory and group-leadership responsibilities. In establishing these factors, we must study the actual situation in each area of technology by first-hand observation, by examining job descriptions by industry and by obtaining information and experience reports from experts concerning the scope and depth of activities involved.

30 India has made good progress on these lines in organising the machinery to collect the data required for manpower planning. Detailed information is being collected about the number of persons employed and their occupational classifications in all public sector and private sector concerns employing 25 persons or more. The total number of persons involved in this process is currently about 14 millions. We are also compiling the occupational data, not just by broad categories, but in detail under 3,600 occupational denominations according to a five-digit structure with brief descriptions of each category. This classification is based on a job analysis conducted by trained occupational analysts in important establishments throughout the country. We are extending the work to units employing 10–25 persons, and ultimately to units employing 5–10 persons, throughout India. When these studies are completed we will be in a position to account for the total labour force of 25 million employed persons, their occupational classifications and levels of training. This will give us a comprehensive and logical basis for manpower planning for economic development.

31 Employment market information is yet another instrument devised by us in India for manpower planning. In addition to bi-annual data that we collect for occupations both in the public and private sectors, we receive quarterly returns that enable us to record changes in employment by regions and by industries. This information also enables us to estimate shortages with reference to unfilled vacancies. On the basis of this information, we can advise employment-seekers and those who are in charge of training programmes.

32 In identifying the subject-fields in which engineers and technicians should be trained we would do well to remember the changing nature of engineering itself. At first, engineering was broadly divided into civil and construction engineering, mechanical engineering, electrical engineering, chemical engineering, metallurgical engineering and mining engineering. While these broad divisions still exist as academic formations in a technical institute, the dividing lines between the several fields are becoming less and less sharp under the impact of scientific and technological advance. Also, modern industry is, for its development, increasingly dependent on an inter-disciplinary approach to problems of design, construction and production, as well as to the discovery of new materials and processes. What is even more significant is the collapse of the traditionally rigid boundaries between the fundamental and applied sciences. For instance, the discovery of super-conductivity and super-fluidity in solid state physics and the development of transistors have telescoped physics into electrical and electronics engineering. A new field of materials technology has grown that transcends the boundary between science and engineering on the one hand, and on the other, the sharp distinctions between one branch of engineering and another. A surer understanding of the mathematical and physical basis of plasticity, elasticity and stress analysis has led to new design

concepts and applications particularly in aeronautical engineering and structural engineering. Therefore, what our engineers and technicians need is not merely professional competence in selected fields of their speciality. They need depth, flexibility and a capacity for growth in directions in which we ourselves can today only dimly visualise developments. The business of an engineering education is to provide would-be engineers and technicians with a foundation upon which they may build a career of genuinely professional stature that is responsive to both socio-economic change and scientific and technological advance.

33 On a quantitative plane, manpower projections are most important within the total economic development plan of a country. However, each country must evolve and refine its own techniques and methods for manpower projections. We, in India, started in 1947–48 with an elaborate technique of Production to Personnel Ratio. We studied, for each group of industries, the quantitative relationship between the production capacity of different units and their pattern of employment of technical personnel. Based on this ratio, estimates were made of the total demand for engineers, technicians and skilled workers for five-year and ten-year periods in relation to the physical targets visualised for those periods. Later, we changed this method for the third Five-Year Plan and tried to establish a simple relationship between financial investments for development and the technical personnel needed. We found that for an investment of 10 million rupees (half a million pounds sterling) in economic development, twelve technically qualified persons are needed in the proportion of four engineers to eight technicians. We are, however, not quite satisfied with this method because it is not sufficiently flexible to meet the inevitable new situations that arise in the course of plan-execution. These are technological changes that demand development and application of new techniques, new plant and machinery and new managerial skills; there is the rise in the cost of plant and machinery, in the cost of raw materials and changes in the economic and financial policies of Government. Therefore, for the fourth and fifth Five-Year Plans covering the next ten years we propose to make manpower projections by relating various inputs to economic growth rate. Our planners have visualised a compounded growth rate of 11 per cent in our national income from industry and other sectors of economic development that are technology-based. Technical manpower is one of the main inputs for securing economic growth, and we therefore presume that the demand for engineers and technicians will grow at the same rate. In other words, the rate of economic growth measured in terms of productivity, or output or G.N.P., and the rate of increase in the total manpower stock to sustain the economic growth have a one-to-one correspondence. Our total stock in engineering personnel is about 100,000 engineers and technicians. We are planning, therefore, to increase this stock by about 13 per cent each year. The extra 2 per cent is intended to meet attrition in the total stock due to retirement, death, etc., of serving personnel. On the basis of these projections, we propose to increase the annual admissions to engineering colleges to about 30,000 and to polytechnics to over 68,000 by the end of the fourth Plan period. In providing for these admissions to our technical institutes we will balance the output of engineers and technicians in the proportion of one engineer to at least three technicians. The actual experience of the fourth and fifth Five-Year Plans will determine whether this method of manpower projections is reliable and valid.

34 One last word on the status of technicians. The issue is not moral but it is strictly professional and is relevant to the nature and complexity of the duties and responsibilities of a technician. As a technician moves up by design to positions that were once held by engineers, his status and salary must improve. Employers must recognise that salaries for different technical positions must be determined in relation to the duties and responsibilities involved, and not in relation to the academic and professional qualifications of the recruits. We must also recognise a three-man team of engineer, technician and skilled-worker as the essential base of modern industrial development.

35 To raise the status of a technician, we must increasingly provide him with opportunities for professional advancement. An important step in this direction is to create facilities for part-time and correspondence courses at the professional engineering level that can be utilised by working technicians. After they have qualified through such courses, the technicians must be given positions of higher executive or managerial responsibility with corresponding improvements in their salaries. In India today, we are building into our technical education system part-time courses in engineering at the university first degree level, particularly for the benefit of those who have taken polytechnic diplomas and are serving as technicians in industry.

36 Only five years ago, somewhat less than one per cent of the total enrolments in our engineering institutes was all that existed in any type of part-time courses. Since then, we have set up part-time courses at over thirty centres that have an enrolment of about 10,000 students, drawn mainly from industry and the technician group of personnel. We propose that at least 10 per cent of the demand for graduate-engineers for our fourth and fifth Plans should be met through part-time courses.

37 Do we need a separate professional body for technicians? I am not sure yet. Since, however, the training of a technician and his functions lie nearer the professional engineering level, it seems desirable to have one single professional body for both engineers and technicians, but with different grades of membership. It is also necessary for the professional body to establish procedures whereby a technician-member can qualify for the engineer-membership either through an appropriate system of examinations held by the professional body or through part-time courses conducted by technical institutes. What we truly need is a cross-fertilisation of engineers and technicians.

APPENDIX

Basic Economic and Technical Data Regarding India

TABLE I

Outlay and Investment for the Fourth Five-Year Plan: Public and Private Sectors

(Rs. crores)

Head of development	Public sector			Private sector investment	Total investment	Total Plan outlay (public and private sectors)
	Total	Current outlay	Investment			
1	2	3	4	5	6	7
Agriculture, community development and co-operation	2,410	835	1,575	900	2,475	3,310
Irrigation	964[1]	—	964	—	964	964
	3,374	835	2,539	900	3,419	4,274
Power	2,030	—	2,030	50	2,080	2,080
Small industry	370	140	230	320	550	690
Organised industry and mining	3,936	—	3,936	2,350	6,286	6,286
Transport and communications	3,010	—	3,010	630	3,640	3,640
	9,346	140	9,206	3,350	12,556	12,696
Education	1,210	740	470	90	560	1,300
Scientific Research	140[2]	50	90	—	90	140
Health	492	343	244	—	244	587
Family Planning[3]	95					
Water supply	373	—	373	—	373	373
Housing and construction[4]	280	—	280	1,500	1,780	1,780
Welfare of backward classes	180	115	65	—	65	180
Social Welfare	50	40	10	10	20	60
Craftsmen training and labour welfare	145	65	80	—	80	145
Public co-operation	10	7	3	—	3	10
Rural works	95	—	95	—	95	95
Hill areas and special areas	50	15	35	—	35	50

Rehabilitation	90	30	60	—	60	90
	3,210	1,405	1,805	1,600	3,405	4,810
Other programmes	70	20	50	—	50	70
Inventories	[5]	[5]	[5]	1,900	1,900	1,900
TOTAL	16,000	2,400	13,600	7,750	21,350	23,750

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[1] Includes Rs.24 crores for Tenughat Dam (Bokaro).

[2] An additional amount of about Rs.70 crores has been provided for scientific research under agriculture, health, industry, irrigation, power, transport, etc., bringing the total provision of Rs.210 crores for scientific research as a whole.

[3] Department of Family Planning has proposed an additional outlay of Rs.144 crores in the fourth Plan. It has been decided that any additional amount that this programme can usefully spend will be provided through the annual Plans.

[4] In addition, funds are likely to be available from the Life Insurance Corporation and the Employees' Provident Fund for investment in housing programmes.

[5] Part of the inventories under public sector is covered in sectoral outlays; part will be financed through the banking system.

TABLE II

National Income

National income in 1970–71 (on the basis of the Plan targets)	Rs.23,900 crores
National income in 1970–71 (assumed achievement)	Rs.23,100 crores
National income in 1964–65	Rs.16,630 crores
National income in 1965–66	Rs.15,930 crores
Per capita income in 1964–65	Rs.348
Per capita income in 1970–71	Rs.417

TABLE III

Selected First, Second and Third Plan Achievements and Fourth Plan Targets

Item	Unit	1950–51	1955–56	1960–61	1965–66	1970–71
1	2	3	4	5	6	7
1. National income at 1960–61 prices	Rs. crores	98,500	11,670	14,140	15,930	23,100
2. *Per capita* income at 1960–61 prices	Rs.	275	299	326	325	417
3. Employment generated (addl. Plan-wise)	Million numbers	—	7	9	13	18·5 to 19·0
4. Agricultural production—index numbers	1949–50 = 100	95·6	116·8	142·2	158·3	207·8
5. Foodgrains production	Million tonnes	54·92[1]	69·22[1]	82·02	72·29	120·0
6. Irrigation-utilisation (Plan-wise)						
(*a*) minor—(addl.-gross)	Million acres	—	9·5	9·0	13·1	17·0
(*b*) major and medium—(addl.-gross)	Million acres	—	3·1	5·2	5·5	9·0
7. Co-operation: short and medium-term loans advanced	Rs. crores	22·90	49·62	202·75	400·0	650·0
8. Industrial production—index numbers	1956 = 100	73·5	91·9	130·1	181·6	306·0
9. Coal	Million tonnes	32·8	39·0	55·7	70·0	106·0
10. Iron ore	Million tonnes	3·0	4·3	11·0	32·0	54·0
11. Petroleum products	Million tonnes	0·2	3·4	5·8	9·9	20·0
12. Steel						
(*a*) steel ingots	Million tonnes	1·47	1·74	3·4	6·2	11·7
(*b*) finished steel	Million tonnes	1·04	1·3	2·3	4·6	8·8
13. Machine tools (graded)	Value in Rs. lakhs	30	80	700	2,300	10,500
14. Agricultural tractors	'000 numbers	—	—	neg.	3·2	35·0
15. Fertilizer production						
(*a*) nitrogenous	'000 tonnes of N	9	80	99	233	2,000
(*b*) phosphatic	'000 tonnes of P_2O_5	9	12	54	111	1,000
16. Cement	Million tonnes	2·73	4·67	7·97	10·8	20·0

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[1] Adjusted for statistical changes with 1960–61 as base.

TABLE IV

Matriculates, Intermediates, Graduates and Total Workers by Industry (1961)

(Thousands)

Industry group	Below Matric	Matriculates	Intermediates	Graduates	Total Workers
1	2	3	4	5	6
1. Agriculture	130,648	381	46	67	131,142
2. Mining, etc.	5,143	68	5	6	5,222
3. Manufacturing	19,377	436	89	104	20,006
4. Construction	1,911	99	30	19	2,059
5. Trade and Commerce	7,009	452	101	92	7,654
6. Transport and Communications	2,528	318	80	93	3,019
7. Services (Other)	16,895	1,509	405	765	19,574
Public services	3,711	722	245	296	4,974
Educational services	1,584	467	103	289	2,443
Medical and health services	765	124	27	48	964
Religious and welfare services	1,082	38	6	26	1,152
Legal services	119	39	1	60	219
Business, trade, labour association and community services	191	37	6	7	241
Recreation, personal and other services	9,443	81	18	37	9,579
TOTAL	183,511	3,262	756	1,147	188,676
					(Percentage)
1. Agriculture	99·6	0·3	..	0·1	100·0
2. Mining, etc.	98·5	1·3	0·1	0·1	100·0
3. Manufacturing	96·9	2·2	0·4	0·5	100·0
4. Construction	92·8	4·8	1·5	0·9	100·0
5. Trade and Commerce	91·6	5·9	1·3	1·2	100·0
6. Transport and Communications	83·7	10·5	2·7	3·1	100·0
7. Services (Other)	86·3	7·7	2·1	3·9	100·0
TOTAL	97·3	1·7	0·4	0·6	100·0

Note: The totals do not tally on account of rounding.

TABLE V

Estimated requirement of Matriculates and above by Industry Group (1960 *to* 1986)

(Thousands)

Industry Group	1960–61 (actual)			1975–76			1985–86		
	Matriculate	Intermediate	Graduate	Matriculate	Intermediate	Graduate	Matriculate	Intermediate	Graduate
1. Agriculture	381	46	67	681	83	120	984	120	174
2. Mining	67	5	6	282	20	27	632	45	61
3. Manufacturing	436	90	102	2,880	584	707	6,681	1,355	1,642
4. Construction	99	30	19	503	150	97	1,131	337	218
5. Trade and Commerce	452	100	92	1,181	262	240	2,565	570	522
6. Transport and Communications	318	80	94	1,200	301	354	2,608	654	769
7. Services (Other)	1,509	404	765	4,147	1,040	1,754	6,677	1,653	3,156
Public services	723	245	296	1,299	441	533	1,923	652	789
Educational services	467	102	290	2,123	463	877	3,041	668	1,728
Medical and health	124	27	47	379	82	175	1,139	248	360
Other services	195	30	132	357	54	169	574	85	279
TOTAL	3,262	755	1,146	10,874	2,440	3,299	21,278	4,734	6,542

TABLE VI

Enrolments in Education

(Thousands)

	1960–61			1975–76			1985–86		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Pre-Primary	5,381 (27·5)	3,231 (17·0)	8,612 (22·3)	5,000 (18·9)	5,000 (20·1)	10,000 (19·5)	5,000 (20·5)	5,000 (22·1)	10,000 (21·3)
Primary									
Classes I–IV	17,170 (74·0)	7,826 (35·0)	24,996 (54·8)	38,066 (109·7)	33,484 (68·6)	71,550 (89·7)	39,509 (110·0)	36,730 (110·0)	76,239 (110·0)
Classes V–VII	5,587 (35·5)	1,876 (12·5)	7,463 (24·3)	19,774 (81·9)	12,620 (55·7)	32,394 (69·2)	25,214 (90·0)	23,500 (90·0)	48,714 (90·0)
TOTAL	22,757	9,702	32,459	57,840	46,104	103,944	64,723	60,230	124,953
Secondary									
Classes VIII–X (General)	2,876 (19·9)	706 (5·2)	3,582 (12·8)	8,558 (38·3)	3,309 (15·6)	11,867 (27·3)	13,221 (48·3)	6,274 (24·5)	19,495 (36·8)
Classes VIII–X (Vocational)	65 (0·5)	35 (0·3)	100 (0·4)	546 (2·4)	272 (1·3)	818 (1·9)	3,305 (12·1)	1,568 (6·1)	4,873 (9·2)
Classes XI–XII (General)	418 (4·7)	73 (0·9)	491 (2·8)	1,262 (9·1)	354 (2·7)	1,616 (5·9)	2,502 (14·4)	935 (5·7)	3,437 (10·2)
Classes XI–XII (Vocational)	299 (3·3)	59 (0·7)	358 (2·1)	1,089 (7·9)	284 (2·1)	1,373 (5·1)	2,502 (14·4)	934 (5·7)	3,436 (10·2)
TOTAL	3,658	873	4,531	11,455	4,219	15,674	21,530	9,711	31,241

TABLE VI—*(continued)*

Enrolments in Education

(Thousands)

	1960–61			1975–76			1985–86		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Higher									
Undergraduate (Arts, Science and Commerce)	351 (2·8)	83 (0·7)	434 (1·8)	1,038 (5·5)	312 (1·7)	1,350 (3·6)	1,589 (6·4)	563 (2·4)	2,152 (4·5)
Undergraduate (Professional)	131 (1·0)	15 (0·1)	147 (0·6)	432 (2·3)	99 (0·5)	531 (1·4)	818 (3·3)	230 (1·0)	1,048 (2·2)
Postgraduate (General and Professional)	53 (0·5)	11 (0·1)	64 (0·3)	257 (1·5)	64 (0·4)	321 (1·0)	749 (3·2)	211 (1·0)	960 (2·1)
TOTAL	535	109	645	1,727	475	2,202	3,156	1,004	4,160
GRAND TOTAL	32,331	13,915	46,247	76,022	55,798	131,820	94,409	75,945	170,354

TABLE VII

Estimated Total Future Employment in India (1961 *to* 1986)

(Thousands)

Industry	All workers 1960–61	Workers aged 15 and above		
		1960–61	1975–76	1985–86
1. Agriculture	135,444	123,817	144,462	144,462
2. Mining and Manufacturing	20,927	19,202	40,696	63,861
3. Construction	2,059	1,992	6,653	9,273
4. Trade and Commerce	7,654	7,500	12,135	18,764
5. Transport and Communication	3,019	2,995	6,882	11,525
6. Services (Others)	19,572	18,697	32,906	45,210
TOTAL	188,675	174,203	243,734	293,095

Matriculates and above as Percentage of Total Estimated Employment

(1960–61 to 1985–86)

(Percentages)

	1960–61			1975–76			1985–86		
	Matriculate	Intermediate	Graduate	Matriculate	Intermediate	Graduate	Matriculate	Intermediate	Graduate
1. Agriculture	0·3	..	0·1	0·5	0·1	0·1	0·7	0·1	0·1
2. Mining and Manufacturing	2·4	0·5	0·5	7·8	1·5	1·8	11·5	2·2	2·7
3. Construction	4·8	1·5	0·9	7·6	2·3	1·5	12·2	3·6	2·3
4. Trade and Commerce	5·9	1·3	1·2	9·7	2·2	2·0	13·7	3·0	2·8
5. Transport and Communication	10·5	2·7	3·1	17·4	4·4	5·1	22·6	5·7	6·7
6. Services (Others)	7·7	2·1	3·9	12·6	3·2	5·3	14·8	3·7	7·0
TOTAL	1·7	0·4	0·6	4·5	1·0	1·4	7·3	1·6	2·2

TABLE VIII

Admissions and Output: Technical Institutes

Year	University first degree courses		Polytechnic Diploma courses	
	Admissions	Output	Admissions	Output
1947–48	2,940	1,270	3,670	1,440
1951–52	4,790	2,690	6,220	2,630
1955–56	4,890	4,020	10,480	4,500
1956–57	6,610	4,340	10,320	4,100
1960–61	13,820	5,700	25,800	7,970
1961–62	15,690	7,030	27,690	10,350
1965–66	24,000	10,300	44,000	17,700
1966–67	26,000	13,000	48,000	22,400
1970–71	30,000	21,000	68,000	46,000
1971–72	30,000	24,000	70,000	56,000
onwards till 1976–77 .				

Report of Working Group A(1)— Manpower Planning and Status of Technicians

Chairman: Mr. A. B. Chandiramani (India)

The role of the employer in the education and training of technicians. Consultative machinery.

1 Technician training is a management responsibility and like all other forms of training should be regarded as a normal tool of management. Many employers do not recognise or accept this responsibility and attempt to 'buy in' ready trained personnel from the labour market. It is, however, important to have the direct participation of management in such training. This is so whether training is to be effected 'on-the-job', 'off-the-job' in training centres, through day or block release schemes or through legal enactment such as levy/grant systems, because this leads employers to collaborate in the educational system and to play an effective and responsible role on advisory committees, on governing bodies, on training boards, etc. Collaboration at all these levels is important. At the national and regional levels the concern is with policy-making and the broad strategy of the provision required. At the local levels industry is able to exert a responsible influence upon the content of courses and upon the provision of new and different kinds of courses.

2 In some countries the above may be unrealistic thinking because technicians will sometimes need to be trained in advance of industry being set up, and the aim may be to attract industry by having a partly trained labour force available. In these circumstances collaboration with industries about to be set up should still be attempted and prospective employers asked to make known their range of job requirements, if possible with job analyses, so that the education and training authorities can design appropriate courses. Where the government is training a technician force in advance of the establishment of industry, government must assume an increased share of what would otherwise be the employers' responsibility. Furthermore, authorities must be vigilant to maintain the appropriate balance between the number of technicians and technologists.

3 Further problems in technician training arise in those countries where secondary education is available only to the minority, and in these countries remedial educational services need to be provided for those who have only had a primary education to bring them up to a level at which basic training becomes a viable proposition. Where primary and secondary educational services are still deficient, there is not usually a significant correlation between qualifications possessed and ability potential. This implies, therefore, that countries must recognise that technicians can later be developed by appropriate education and training from amongst those with higher potential who had entered at craft level.

4 Because of the different stages of economic development of the various Commonwealth countries, different systems have evolved for technician education and training. In some countries the educational authorities provide both vocational education and broad-based vocational training; this is often full-time. In others the educational authorities provide the appropriate vocational education and the employers provide the relevant associated training.

5 It is desirable to keep the education and training sufficiently broad-based to enable the technician to be flexible enough to use his talents and his training anywhere within the industry as a whole. Care must always be taken to avoid specialisation which would restrict the technician's flexibility and his scope for future development. A balance needs to be kept between the full development of a country's manpower resources and the usually narrower needs of particular firms or of a particular industry.

6 In some countries the role played by the employer in such training is affected by legal enactments such as the Industrial Training Act of Great Britain and the Pioneer Companies legislation of Malaysia. The first places a legal responsibility on employers to be discharged through Industrial Training Boards who raise levies on employers and pay grants to those undertaking approved training (e.g. United Kingdom Industrial Training Act, 1964). The second requires companies to undertake training as one of the qualifying conditions for tax concessions (e.g. Pioneer Industry Act, 1958, Malaysia). Elsewhere an effective technique has been through a national development corporation which includes training requirements in its contracts with individual developers, both indigenous and foreign. These kinds of measures to require employers to play a fuller and more effective part are felt to be highly desirable, particularly in countries where attempts to enlist the co-operation of employers by encouragement and persuasion have proved ineffective.

The role of the employer in manpower planning

7 Most Commonwealth countries already have research projects into future manpower needs; forecasts have been prepared but frequently they have proved inadequate. One of the problems has been that manpower studies are often commissioned sporadically but perhaps problems created by this may be overcome by a continuous monitoring of such studies.

8 The Working Group noted with approval the following passage in the Willis Jackson report:[1]

> '. . . employers also have a responsibility to plan ahead the nature and scale of their requirements. Such forecasts form an essential part of the data on which manpower policy can be based.'

Some delegates suggested that the agency carrying out the studies should be an autonomous body outside Government but having the authority to require information to be divulged both by Government departments and private employers.

9 At different stages of technological development there is an association between the techniques of production and the ratios of the various categories of manpower employed. For example, the technology of steelmaking is more advanced in some countries than in others and the ratios in which the national steel industries employ operatives, craftsmen, technicians and technologists vary considerably. Thus there is no unique ratio of technicians to other categories of manpower in the steel industry. Those responsible for manpower planning need to take this factor into account.

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[1] GREAT BRITAIN. Committee on Manpower Resources for Science and Technology. Report on the 1965 technical manpower survey of engineers, technologists, scientists and technical supporting staff. London, H.M.S.O., 1966. (Cmnd 3103)

10 There are obvious advantages for the individual employer in effective manpower planning and training. Poaching labour from other employers often results in pushing up wage rates, instead of increasing the supply of manpower, and this in no way benefits either the firm, the industry or the country. Manpower planning and training should not be the responsibility of the Personnel Department but of the Boardroom, e.g. a firm planning extensions in new areas has to realise that the first stage of development might have to be the provision of education and training for the manpower available in that area. An important point here is that the training process to provide new manpower can be lengthy, especially if premises first have to be built, equipment obtained and the staff themselves trained.

11 Failures in manpower planning can be expensive to employers in various ways. If forecasts have not been made in time for training to be carried out expensive personnel from other areas or countries may have to be imported to bridge the gap. Equally, the overproduction of particular types of technicians as the result of faulty planning could mean that expensive training resources, paid for from taxation, had been wasted.

12 A further problem in manpower planning is a lack of standard occupational definitions and this lack makes it difficult to identify the specific technician categories.

The Status of the Technician

13 There are several major factors which affect the status of the technician. Salary is fundamental for status and both public and private employers should create a salary structure in which technician rates are not only over and above craft wages, but well overlapping the professional's salary structure. The outward trappings of status are important, e.g. the usual fringe benefits of 'staff' status. A further factor affecting status is the job opportunities open to the technician for the full development of his talent. Education and training must, therefore, be made available for such development to take place.

14 Certification of technicians was thought to contribute markedly to the technician's status (e.g. the Canadian Certification System and the State Council for Technical Education diploma system in India).

15 An institution of technicians can help to give additional status. There are examples to show that there are perhaps dangers in such a technician institution in that this implies a terminality in the technician's job and so might inhibit and restrict career development through to professional level. It was noted however that there is evidence to suggest that some technician institutions which are terminal in their function are still successful in giving status to their members.

16 The Working Group endorsed strongly the views of the Committee on Manpower Resources already referred to in paragraph 8:

> 'We foresee the need for further careful consideration of the whole problem of the motivation, career structure and status of technical supporting staff. The aim must be to ensure that the career available to the technician increasingly reflects its importance in the structure of technological occupations, and presents a worthy outlet for a wide range of well qualified people.'

17 What is said here about engineers applies with equal force right across the band of technician qualifications including those employed in agriculture, business, health, etc., and employers have an important part to play in this.

Discussion of Report in Plenary Session

Introducing the report, the Chairman of the Working Group emphasised the importance of manpower planning in determining the future requirements for and training needs of technicians, and pointed out that, even in the developed industrialised nations, manpower estimates are still of a very rough and ready nature. Trained personnel to undertake manpower planning and job analysis are in very short supply and there is a need for suitable training courses to be developed. It was noted that some work in this field is being undertaken in Canada and that the Government of Malaysia has established a manpower unit as a permanent feature of its planning machinery.

The importance of close co-operation and collaboration between government and industry was stressed and particular attention was paid to the role of governments as employers. It was agreed that this aspect of government could not be over-emphasised since, in many developing countries, governments are the main employers of technicians and their actions set the tone for the whole economy: there is also a need in some countries to establish a pool of trained technicians before industry could be attracted. There is a tendency for many governments to place too much emphasis on the graduate—this is a legacy from the past—and it is important that governments should set a good example in the intelligent use of non-graduate technician personnel, providing them with the salary and status appropriate to the skilled work which they are required to do.

It was considered important for technicians to be given an opportunity to say what they want in regard to status and a suggestion was made that a 'guild' rather than an 'institution' of technicians is what is required: such a guild could be encouraged to discuss its problems and to seek representation on important national bodies. Some kind of association is important if technicians are to gain the status they deserve but technicians themselves will need to become self-conscious and to earn their right to an enhanced status.

Whilst it was generally agreed that competition for scarce manpower is not good for any country in the long run, some delegates disagreed with the proposition in the report that it is necessarily a bad thing for technician salaries to be forced up by shortages in particular areas. Experience in some countries has shown that it is only because of the demand from employers for a limited number of trained technicians that there is a welcome and necessary increase in the salaries offered.

It was pointed out that the British system of apprenticeships and part-time technician training, which appears to be satisfactory, in practice has encouraged the poaching of trained labour from firms which sponsor training by firms which have not undertaken such training of their own employees: this has necessitated the introduction of the levy/grant system now being operated to help to spread the costs of training more equitably among all firms in a particular industry.

The importance of associating employers and governments with the provision of proper training facilities was stressed. In Britain, education is administered by local education authorities who bear the burden of negotiations with industry and commerce but in most other Commonwealth countries, the government is the chief employer of educational staff and controls education directly: this may create a climate of suspicion between government and industry which could hinder their proper co-operation.

CHAPTER V

Types, Content and Organisation (Including Extension and Correspondence Courses) of Technician Education and Training for Men and Women and its Place in Education and Employment

Lead paper presented by Dr. H. W. French, Chief Inspector (Further Education for Industry and Commerce), Department of Education and Science, London, England.

INTRODUCTION

1 It is not proposed to produce here a detailed definition of a technician. Nevertheless, it is necessary to have a generally agreed concept of the type of student under discussion. Broadly, he (or she) can be described as a person occupying the intermediate position between the craftsman on the one hand and the professional level man on the other. In the engineering context, in which the concept of the technician first arose, the distinction is perhaps fairly clear. The 'professional level man' is usually identified as the University-trained engineer, although there are countries where this same level is achieved by education and training none of which takes place in the University. The engineering craftsman too is fairly clearly defined. However, even in the engineering field there are some occupations which it is not easy to categorise. The technician often needs a considerable amount of that manual skill which is the main attribute of the craftsman. He needs, too, a sound background in mathematics, in science and in the technology of his occupation. In this respect he may well, in certain areas, approach the kind of academic background expected of his 'professional' colleague. Thus clear-cut lines of demarcation often do not exist; and even in engineering there are many examples of technicians who have begun as craftsmen and who have added to their manual skills the necessary theoretical knowledge to enable them to do technicians' jobs successfully. There are some technician courses in the United Kingdom which require a craft course to be passed as an entry qualification. Examples are the Motor Vehicle Technicians course, entry to which requires a pass in the Motor Vehicle Mechanics course; and Electrical Installation C, which is entered by passing the Electrical Craft course. In Switzerland and Denmark, a craft apprentice course is a necessary precursor to a technician's course. At the other end of the scale, there are examples of particular jobs which are carried out either by higher technicians or by professional engineers, since their requirements embody knowledge which is common to both.

2 In recent years, the concept of the middle-level man, previously restricted largely to the field of engineering, has spread far outside it. In the building construction and architecture fields there have now grown up a number of jobs generally recognised as of technician level. In science, there now exist chemical technicians, metallurgical technicians and many others. There are technicians making vital contributions in the medical field. In hotel and catering work, and

in food technology, there are now fairly well-defined technician-level occupations. The idea of 'technicians' in the business, commercial and clerical fields is a relatively new one, and it may be that some more acceptable term may have to be devised. But it seems obvious enough that if one can equate the copy-typist, clerical assistant type of worker with the craftsman in the engineering field, and if business executives with Bachelor of Commerce degrees and equivalent qualifications e.g. chartered accountants, etc., are regarded, as they obviously must be, as at professional level, then there are intermediate posts at 'technician' level. Such posts will include personal secretary-assistants, auditors, data processing personnel, etc. Certain junior executive posts in local or national government service are also at this level.

TYPES OF COURSES

3 The many types of technician courses may be seen from the list shown in the Appendix to this paper, which indicates those which the writer has come across in various parts of the world. It will be seen from this list that there are many courses particularly suitable for women. Obvious ones are Secretarial Courses, Business Administration, the various Home Economics options, Photographic and Graphic Arts, Interior Decorating, Radio and Television Arts, Commercial Art, Medical Laboratory Technicians, X-Ray Technicians, Architectural Draughtsman and others. Developing countries short of technicians cannot afford to ignore the capabilities of women, who are capable of taking a far greater variety of technician courses than those listed above. Indeed, apart from a few courses from which their physical limitations may exclude them, they should be regarded as equally eligible as men for training, if they can pass the selection tests. In this respect developing countries may note the example of the Soviet Union, in which a high proportion of engineers and engineering technicians are women. The writer has seen in Russia classes of electronic engineers in which there were more women than men. Whilst it is realised that in many countries the training of women as technicians would mean overcoming social customs of long standing, it may well be in the national interest to do so. Although there is a great variation in the types of technician produced in various countries, and many differences in the way in which their courses are organised, it is broadly true to say that in most countries it is possible to recognise two levels of technician, who may perhaps be designated 'technicians' and 'advanced technicians'. Generally speaking, advanced technician courses are entered at the age of about 18 or 19, commonly at the end of full-time secondary schooling until that age. Such courses are usually of two or three years duration, full time; or there may be part-time versions involving equivalent study. In some cases such courses are entered by students who have successfully completed lower technician courses. These are commonly begun at the age of 16, and are usually of two years duration. There are some countries where a foundation programme containing many of the elements of a junior technician course is given in secondary schools, and special arrangements are made for such students to enter higher technician courses.

THE BASIC COMPONENTS OF TECHNICIAN COURSES

4 Whilst there is a bewildering variety of technician courses and many differences in their organisation between the various countries, there are certain common factors. For example, most technician courses can be regarded as having five elements, namely:

(i) technical education (theory)
(ii) technical education (practical)
(iii) technology (theory)
(iv) technology (practical)
(v) general education

Frequently, in discussion, these five elements are coalesced to form two, namely 'education' and 'training'. Whilst the boundary between the two is ill-defined, 'education' can be considered to embrace (i), (ii), (v), and commonly part of (iii), while 'training' consists of (iv) and the rest of (iii).

5 By *technical education* (*theory*) is meant that general background of mathematics, physics, chemistry, engineering drawing, etc. (or whatever subjects are relevant to the particular course) which constitute the theory upon which depends a proper understanding of the techniques of which the technician must acquire a mastery. This technical basis should also be sufficient to enable the technician to cope, without too much difficulty, with developments which might arise in his field after he has qualified.

6 By *technical education* (*practical*) is meant the laboratory and experimental work which is concomitant with the theory. Clearly, it should be normal for this work to be done in proper relation to the theory. But it has been listed separately because such an arrangement is not always possible. For example, it may be that the theory has to be provided by correspondence, in which case the laboratory work may have to be done in a solid block of full-time attendance.

7 *Technology* (*theory*) means the theory relevant to the actual equipment with which the technician is concerned and to the specific techniques which he has to exercise. It is frequently useful to link this with the basic theory and with the laboratory work; and it is often very difficult to draw a clear distinction between them.

8 *Technology* (*practical*) means the acquisition of the necessary skills which the technician needs to do his job. This may well include basic manual skills similar to those possessed by the corresponding craftsmen. It may well involve the making of skilled measurements, of tests both simple and complicated. Commonly, the work involves an element of judgement and the intelligent application of background theory. Thus there is much to be said for this work also being integrated with the theory and perhaps, to some extent, with the technical education; but here, again, such an arrangement is not possible if correspondence course methods are used. Also, where the practical technology is acquired by training within industry, as in some cases it may be, there are

difficulties in organising the course in such a way as to ensure that the relevant theory is known by the time the corresponding practical work is reached. One thing is certain. The ultimate valuation which will be placed upon a technician will be in terms of his success in doing a practical job of work. His theory is but a background to enable him to do practical work with certainty and expedition, and to equip him to continue to do this even if equipment and methods change. The 'theoretical technician' is a failure. Thus, whilst each of the five elements in any course is important, the practical technology is particularly so. This is stressed because courses have been encountered in which the theory has been good and the practical work poor. Often this has been because the teachers themselves have lacked practical experience in the work they are trying to teach. In developing countries it is often difficult to find teachers with practical technician experience, and all possible steps need to be taken to minimise the effect of a deficiency of practical know-how on their part, if it exists. It may be necessary for selected teachers to acquire this experience outside their own countries, as is already being done in some cases.

9 Finally, every technician course, but particularly those for junior technicians, needs a *general education* content. One major element in this should be communication, both in speech and writing. A technician is often called upon to diagnose faults and to report upon them; and for this he needs to be able to express himself clearly and succinctly. Frequently, too, a technician has to give instruction to others, and these instructions must be simple and unambiguous. Many technicians have to exercise a measure of supervisory responsibility. Not only should they be taught the principles involved in this but such teaching should be used as a vehicle for exercising communication skills. In many countries, technician students have to receive instruction, and often to do their work, using a language which is not their native one. It is in such cases particularly necessary to include in their general education studies a generous element of work on the language of the course. This language study should preferably be largely directed towards the vocational interests of the student and arid formal exercises should be avoided. An important objective in general education should be to imbue the student with a clear concept of the importance of the job for which he is training; with a picture of his place in the firm, business or government department in which he is, or may be, employed; with the place of the firm or business within industry; with the importance of the industry to the nation's economy; and with the relation of the nation to the rest of the world. In short, the technician-to-be should be educated to realise that his technician's post will not merely enable him to earn enough to keep himself and his dependants, but also to make a useful contribution towards the development of his country. Thus it is necessary also to educate him as a citizen. He should be given a clear conception of how local and national government operates in his country, as well as a glimpse at international affairs. This part of his education should include such matters as employer-labour relationships, and the elements of economics. Also, the liberal education of the students should not be ignored. This may take the form of lectures on literature, art, music, etc., organised, perhaps, very largely as extra-curricular activities. Here too the emphasis may quite properly be towards indigenous culture, so that the student may take a pride in his national heritage. The general education element in a technician's training has been stressed because its importance is not always as fully appreciated as it should be. However, to get the point into proper focus,

it should perhaps be said that it is envisaged that some 10–20 per cent of the total time might be devoted to it. With junior technicians it is appropriate to spend a good proportion of this time enhancing the basic education of the student. For senior technician courses, the emphasis may properly shift towards the supervisory and industrial relations content.

10 Whilst the proportions of the five constituents enumerated may vary considerably between one technician course and another, the following breakdown of a 3-year full-time technician course is given as an example. It is, in fact, the Electronic Technology programme given in greater detail in Table II. Like most electronic courses, it properly contains a higher ratio of theory to practice than is general in technician courses.

TABLE I

	per cent	
Technical education (theory)	37·8	
Technical education (practical)	22·2	Theory 54·5 per cent
Technology (theory)	16·7	Practical 33·3 per cent
Technology (practical)	11·1	
General education	12·2	General 12·2 per cent

ORGANISATION OF COURSES

11 Another factor which may have considerable influence upon the proportion of the five constituents is the manner in which the course is organised—whether, for example it is a full-time integrated course, as in many countries, or whether, as is common in the United Kingdom, the course is made up of one day a week in college and four days a week in industry. The possible ways of organising technician courses will now be examined and their advantages and disadvantages considered. It is vital that a country about to organise (or reorganise) its system of technician education and training should adopt that system (or systems) which is best suited to its particular circumstances, and not simply copy another country's system, however well-tried and successful this may be. Only if the two countries 'match up' will success result from a straight duplication, and examples exist where overseas experts who have endeavoured to set up in developing countries a simple image of their own system, have thereby done little good, and perhaps a positive disservice, to the countries concerned. An obvious example of a system which is virtually unexportable is the United Kingdom one, which relies heavily upon industry for the training of its craftsmen and technicians, the firms and businesses providing training for four days a week, and a large network of colleges covering the educational content during one day a week. This is an excellent system for a highly industrialised, heavily populated country where distances are small. It is entirely inappropriate for a large developing country with small, widely distributed pockets of industry and commerce, and but a few technical colleges, widely separated. Such a country must almost inevitably organise most of its technician training in terms of full-time courses, or else utilise a combination of short full-time courses and correspondence tuition. In this context it is interesting to note from the paper submitted by the City and Guilds of London Institute[1] that, whilst the courses which it has designed for the United Kingdom are in the main tailored to meet the needs of part-time students, the courses designed specifically for technician students overseas are full-time courses. (The part-time programmes are, of course, equally available for overseas countries where circumstances are appropriate for their use.)

Full-time Integrated Courses

12 Full-time courses have powerful advantages. Since all their five elements are under the control of the college in which the course is located, the maximum degree of integration can be achieved. Theory and practice can, by skilled teachers, be immediately related. To take a simple example, if an electronic technician is taught the theory of a particular kind of amplifier, the laboratory work which follows can involve making the amplifier and carrying out tests, varying the conditions in order to investigate and verify the theory. The technology associated with this may well be the use of standard test equipment to measure the characteristics of such an amplifier in a commercial piece of equipment. This can then be done, and a report produced in the form which is recognised industrial practice. In many European countries the full-time course is the standard method, and it is highly regarded. But its shortcomings are also well known. Commonly, the technical and general education may be provided very well in a full-time college; but the technology is sometimes limited, perhaps by available equipment but much more frequently by a lack of the practical industrial or commercial situation. Because of this, the technology practical work may be on a smaller scale than is met within industry; it may well have an element of artificiality about it. This will obviously be so in, for example, such courses as plant engineering, civil engineering, and others relating to heavy industry. It is not only the scale, but also the atmosphere, which falls short. The students lack the inherent urgency and interest which attaches to work being done as part of a production, maintenance or business job. There is something real and important in what the French call 'l'esprit d'entreprise'. The technician apprentice in the United Kingdom may well find himself learning by planned practical work in a production shop or in a drawing office in which the drawings are not merely exercises but the early stages of work which will end in saleable hardware. It makes a difference. Where wholly institutional courses are inevitable, all possible steps should be taken to simulate in the practical work industrial or commercial conditions as closely as possible. This should extend to normal works or office discipline during the technology work and to the observance of normal stores production and office procedures.

13 Such a full-time institutional course should necessarily have a good practical technology content. Outlines of four full-time programmes, one a three-year course in Electronic Technology, the second a two-year course in Architectural Technology, the third a three-year Secretarial course and the fourth a two-year course in Baking Technology are given in Tables II, III, IV and V respectively.

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[1] Conference Paper C.E.T.T.(P)7/2 (See Appendix II).

TABLE II

Electronic Technology—3-Year Programme

1st Year

Subject	Lecture hrs.	Lab./W.S.
English I	90	—
Economics	60	—
Mathematics I	90	60
Chemistry	90	60
Physics I	60	60
Electricity	90	60
Applied Mechanics and Drawing	60	60
Physical Education	—	60
	540	360
	900	

2nd Year

Subject	Lecture hrs.	Lab./W.S.
English II	90	—
Mathematics II	120	—
Physics II	90	90
Electronics	90	60
Electric Circuits I	120	90
Electronic Circuits I	90	60
	600	300
	900	

3rd Year

Subject	Lecture hrs.	Lab./W.S.
English III	60	—
Mathematics III	120	—
Electronic Circuits II	90	60
Communications	90	60
Pulse Circuits	90	60
Electronic Systems	60	60
Control Systems	90	60
	600	300
	900	

TABLE III

Architectural Technology—2-Year Programme

1st Year

Subject	Lecture hrs.	Lab./W.S.
English and Communication I	120	—
Mathematics I	180	—
Physics	120	60
Materials and Methods I	90	90
Statics	60	30
Architectural Drawing I	90	270
Data Presentation	30	—
Design	30	30
	720	480
	1,200	

2nd Year

Subject	Lecture hrs.	Lab./W.S.
English and Communication II	90	—
Mathematics II	30	—
Materials and Methods II	30	30
Structural Design	90	60
Architectural Drawing II	90	300
General Design	—	150
Mechanical Equipment	30	—
Specifications, Estimates and Contracts	90	90
Concrete Practice	30	30
Sanitary Engineering	30	30
	510	690
	1,200	

TABLE IV

Secretarial Course—3-Year Programme

1st Year

Subject	Hours
English I	120
Business Law	90
Economic Principles	90
Political and Economic Geography	90
Shorthand I	210
Typewriting	150
World History (19th Century)	90
	840

2nd Year

Subject	Hours
English II	150
Introduction to Business	90
Psychology	90
Secretarial Science I	210
Shorthand II	210
World History (20th Century)	90
	840

3rd Year

Subject	Hours
English III	120
Philosophy and Modern Life	60
Secretarial Accounting	120
Secretarial Science II	210
Shorthand III	210
Sociology	90
	810

TABLE V

Baking Technology—2-Year Programme

1st Year

Subject	Lecture hrs.	Practical
English and General Studies	108	—
Breadmaking and Fermented Goods *or* Biscuit Manufacture	108	108
Flour Confectionery	108	108
Design and Cake Decoration	54	54
Biochemistry, Microbiology and Hygiene	144	144
Source and Properties of Raw Materials	54	—
Plant and Equipment	36	—
Business Organisation	90	—
	702	414
	1,116	

2nd Year

Subject	Lecture hrs.	Practical
English and General Studies	108	—
Breadmaking and Fermented Goods *or* Biscuit Manufacture	72	108
Flour Confectionery	108	144
Biochemistry, Microbiology, Nutrition and Hygiene	108	144
Properties and Testing of Raw Materials	36	72
Business Organisation	90	—
Human Relations and Legal Aspects	36	—
Packaging and Distribution	54	—
Plant and Equipment	36	—
	648	468
	1,116	

Note: This course, planned as a 2-year full-time course with 36 weeks a year, can also operate as a 3-year sandwich course for 24 weeks a year.

'Open Sandwich' Course

14 One method of resolving the difficulty referred to above is to leave the technology part to industry, by organising the course on an 'open sandwich' arrangement. In this, all five elements of the course are provided in the college for the first year but in the second year the technology (practical) element is largely omitted. It is subsequently provided as planned training within industry, the practical work being designed jointly by the college and industry, and the award of the Diploma withheld until after the successful completion of the industrial training period. The restriction of the industrial training arrangement to the second year is justified on the grounds that the practical training in the first year necessarily includes a proportion of work involving basic skills, such as colleges can provide without much difficulty. It is in the later stage of the course that the practical technology may involve equipment and installations which a college may have difficulty in providing. By using the facilities of industry, not only is this difficulty overcome, but so is the problem of achieving an industrial atmosphere.

'Sandwich' Courses

15 A further step is the 'sandwich' course, in which the practical technology is provided by industry in each year of the course. The normal arrangement is for about six months of each year to be spent in the college and the other six months in industry. It is important to note that, as soon as an arrangement is made where two elements of the course take place in different establishments, the difficulty of correlation between the two parts arises. This almost inevitably results in some overlapping. For example there is often a measure of duplication between the technical education (practical) done in the college and the technology (practical) done in the works, since the boundary between the two is seldom clearly defined. Whilst the college teacher may often find it good practice to enhance his teaching by reference to, and perhaps use of, equipment which is more relevant to the technology (practical) part of the course, the instructor in industry, mainly concerned with the practical technology, may find it necessary from time to time to revise the corresponding technology theory. Indeed, unless the two parts of the course have been particularly well organised, the instructor in the firm may find that some relevant parts of the technology theory may not have been covered by the time he needs them. To minimise this problem it is necessary to establish a really effective liaison between the industry or business on the one hand and the college on the other; between the trainers and the teachers. Thus the immense advantage which training in an industrial or business environment can bring is bought at a price. The cost is administrative complexity, and a real problem in the matter of effective teaching, since to have practical technology in the hands of one person and the relevant theory in those of another can restrict the effectiveness of both. Another problem which arises is that, if the theoretical work is concentrated into one half of each year, it may well be forgotten during the other. Many sandwich courses are therefore organised so that, during the works periods, there is either some part-time—commonly evening—attendance at the college, or else the link is maintained by correspondence work.

16 The half-and-half arrangement of the 'sandwich' course has the great advantage that, if desired, it can be organised 'end-on'. By this is meant that two courses can be run concurrently, one being in college whilst the other is in the works. This can maximise the usage of both college and works training facilities. The half-and-half system is not, of course, the only possible college/industry division. Indeed, it is clear that it is only completely appropriate for those courses where practical technology properly constitutes nearly 50 per cent of the course.

17 An example of a two-year sandwich course for agricultural technicians is shown in Table VI. The first year's college attendance of twenty-five weeks is followed by planned training, as far as is possible, on the farm. This accounts for the smaller practical content of the second college session, which is also followed by training 'on the job'.

TABLE VI

Agricultural Technician—2-Year Sandwich Course

1st Year

Subject	Lecture hrs.	Practical
English and General Studies . . .	50	—
Agricultural Economics and Accountancy .	50	—
Farm Mechanisation and Operations . .	75	50
Bacteriology	50	50
Botany	75	100
Agricultural Chemistry	75	75
Zoology	50	50
	425	325
	750	

2nd Year

Subject	Lecture hrs.	Practical
Animal Health	50	—
Animal Husbandry	100	—
Crop Husbandry	100	—
Economics and Business Management .	75	—
Farm class and Mechanisation . . .	100	175
Buildings and Surveying	25	—
Tutorial	75	—
English and General Studies . . .	50	—
	575	175
	750	

Block-Release Courses

18 There are some courses, often of longer total duration than the full-time integrated course or the sandwich course, where the length of college attendance may be much less than six months a year. For example, there have recently been developed in the United Kingdom what are known as block-release courses, some involving about twelve weeks of college attendance per year, and others about sixteen or eighteen weeks. Such an arrangement provides for a higher proportion of practical technology than does the half-and-half course and it is necessary to ensure, as far as possible, that the relevant theory is covered before the practical technology in the training is undertaken. In the later stages of the course the practical training may well involve some production or equivalent work; that is the training may be extended to include an experience element. This kind of arrangement also produces the problem of continuity between the college periods. It too may be solved by either occasional—usually evening—attendance, or by correspondence assignments. It will be noted, too, that this system can also enable a highly efficient use of facilities to be achieved. If colleges are open for forty-eight weeks a year, and there are twelve weeks of college attendance, then clearly five trainees can be handled for every four industrial training places. If the courses are of sixteen weeks duration in college, then four trainees can be handled for every three industrial training places available.

Day-Release Courses

19 Next, one reaches the day-release arrangement, where the college course occupies one day per week (with, perhaps, an additional evening—say nine or ten hours a week), the other four days a week being spent in training within industry. The sort of time distribution which is common for day-release is shown in Table VII, which summarises a course programme for Chemical Technicians.

TABLE VII

Chemical Technicians—2-Year Part-Time Day and Evening

1st Year

Subject	Lecture hrs.	Practical
English and General Studies	57	—
Mathematics and Physical Science	38	19
Chemistry	57	—
Chemical Laboratory Procedures	38	152
	190	171
	361	

2nd Year

Subject	Lecture hrs.	Practical
English and General Studies	38	—
Mathematics and Physical Science	38	—
Chemistry	57	—
Chemical Laboratory Procedures	38	190
	171	190
	361	

The basis of the course is one day (7½ hours) plus one evening (2 hours) a week in the college.

The course is for junior technicians entering at the age of 16. It is followed by a 2-year course for advanced technicians, with a similar course structure.

20 Day-release is a normal arrangement for engineering and science technicians in the United Kingdom, and is now extending into the business studies and other fields also. Many educationalists feel that the 'weekly dose' of college has much to commend it, compared with the concentrated effort asked of the students in block-release courses, and the 'forgetting periods' between. Even so, there is now a body of evidence which shows that, in terms of examination results, technician students do better on block-release than on day-release courses. This may well be because the actual time devoted to educational studies is greater for block-release students than for part-time day students, for whom, in many courses, it is all too little. A 12-week block-release course involves about 360 hours of attendance, augmented by, perhaps, from 50 to 100 hours of evening attendance during 'link' periods. For 18-week courses, the corresponding periods may be 540 hours during the block, plus 40 to 80 during the link periods. On a day-release scheme the commonest arrangement is a seven-hour day for 38 weeks, giving 266 hours. At most, a seven-and-a-half-hour day augmented by a two-and-a-half-hour evening would give 380 hours. Many educationalists take the view that the day-release arrangement, however adequate it may be for craft training, provides an inappropriate ratio of education and training for technicians, because of the greater theory content of their courses. Thus there is a trend towards block-release courses for technicians in the United Kingdom, although block-release students still constitute a minority.

21 In part-time day arrangements, as indeed in all schemes which involve carrying out the training within industry, the question of the quality and the control of the training looms large. In the United Kingdom there are some firms and some nationalised industries which provide technician training of high quality and which, by close liaison with the colleges providing the education element, prove that the day-release arrangement can work well. They often get the ratio of the five constituents nearer the appropriate figures by giving their students not only the technology (practical) element, but also a measure of the technology theory. Much of what they do, at any rate in the early part of the course, is provided in 'training bays' or in some other accommodation within the works, but which is not part of the actual production facilities. There are also, in the United Kingdom, a number of establishments provided by the Ministry of Labour, and known as Government Training Centres, where initial courses involving four days a week of practical technology, plus some related theory, are provided. Whilst these are mainly for craftsmen, a few technician-level courses are available. There is, of course, good liaison between these establishments, which provide students with training, and the colleges which provide the education. Such establishments while they do not provide the true industrial environment such as a firm itself can produce, nevertheless usually have some advantage over colleges in that they concentrate on training only, and can thus set up working conditions which can approach closer to those which exist in industry than can most colleges. Colleges, with a wide range of courses, necessarily provide an environment which cannot avoid being to some extent a scholastic one, despite the excellent efforts which many make to bring realism into such training as they may give.

Evening Courses

22 The British part-time day arrangement developed historically from the situation which existed some fifty years ago, when craftsmen and technicians picked up their practical knowledge as best they could on the job and acquired their technical education by voluntarily attending evening classes, commonly for three evenings a week. The Department of Education and Science has stated firmly that technicians should not have to obtain their technical education by evening studies alone; that they should, at least, be given day-release; but preferably, their courses should be of the block-release, sandwich or integrated full-time nature. It may well be necessary, however, for evening courses to be provided for adult students who have missed the opportunity of obtaining normal technician courses whilst of apprenticeship age: or who, having as apprentices reached the junior technician level, wish to obtain an advanced technician qualification. It is for consideration, however, whether a firm which is suffering from a shortage of advanced technicians, as many are, might not be better advised to offer day-release or block-release even to adult students.

Correspondence Courses

23 There can be no doubt that technician education and training must depend immensely for its success upon the face-to-face confrontation of teacher and taught; and upon the facility for augmenting theory with immediate demonstration and practice. These are advantages which should be sacrificed only where there is no option but to do so. One must face the fact however that in many countries it may be virtually impossible to organise certain technician courses on the basis of any of the attendance arrangements outlined above, and recourse must needs be made to correspondence courses. This is especially true for advanced technician courses, continuative (up-dating) courses, and others where numbers are likely to be small, and students so widely scattered, that attendance courses may be impracticable. Whilst correspondence courses obviously have severe limitations, the papers presented by the governments of Australia and New Zealand[1] show very clearly that if they are organised well they may make an important contribution to the supply of technician and other man-power.

24 The technique of writing correspondence course assignments, and of marking them in such a way as to provide the students with the maximum amount of assistance and encouragement, are not abilities possessed, necessarily, by all good teachers. The operation of really successful correspondence courses calls for the direction of experts in this field. These points are made at length and with admirable clarity in the Australian and New Zealand papers, and will not therefore be expounded at length here. Another point of great importance also made is the need for correspondence courses to lead to the same educational qualifications as are available to students following courses of a more conventional type.

25 It is of course essential for the theory provided by correspondence to be augmented by practical work. This is often provided by a block attendance at a college, and must ensure that, as far as possible, both technical education (practical) and technology (practical) are covered. It is often difficult to organise college attendance blocks of sufficiently long duration to achieve as much technology (practical) as one might wish. However, this may well be less important for correspondence students than for the others, since the former are

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[1] Conference Papers C.E.T.T.(P)2/2 and C.E.T.T.(P)2/5 (See Appendix II).

commonly employed in a relevant sphere whilst undergoing the assignments. Indeed, as will be seen from the papers quoted earlier, it is often a condition of enrolment that the student is in suitable employment.

26 The limitations of instruction solely by the written word should be offset by whatever visual, and possibly audio-visual, aids as may reasonably be introduced. Obvious examples are diagrams and photographic illustrations. Some correspondence courses are now augmented by slides or film strips, each student being provided with a cheap battery-operated slide viewer. Audio tapes are now used in conjunction with technical and commercial courses. Whilst the use of tapes and records for such subjects as language, typewriting and shorthand in commercial courses is well established, similar techniques can be used in connection with certain technical courses. For example, in an auto-motive engineering course it might be useful to provide recordings of engine sound under various fault conditions.

27 Where possible too, the use of radio and television as an adjunct to correspondence courses should be carefully considered. Such methods not only enable the isolated student to hear, and perhaps see, in his own home a really expert teacher, but such programmes can be taped or telerecorded for use in attendance colleges also. This is a particularly attractive point in countries where expert specialist teachers are in very short supply.

28 Finally, operators of correspondence courses need to give particular thought to the techniques of programmed learning. This system, like a correspondence course, enables a student to progress at his own pace. The fact that good programmes have a large measure of built-in self-assessment has two great advantages. From the students' point of view the advantage comes from a marked reduction in the volume of written work required—this volume being a potent source of student wastage in correspondence courses. From the point of view of the course organisers the advantage of programmed learning is that it can reduce the amount of marking involved in the course. Thus, when courses are revised, the possibility of producing the new ones in programmed form should be considered.

Technician Courses in Secondary Schools

29 All the methods dealt with so far—full-time integrated courses, sandwich, block-release, part-time day, evening only, correspondence—are equally applicable to either the lower or the higher level of technician training. Considering for the moment the sixteen-year-old entrant, there is a clear distinction made at this age between those who go into employment and those who do not. In the United Kingdom, and certain other European countries, the former enter some form of technician apprenticeship or learnership, which may involve an initial period of full-time off-the-job education and training, followed by training in industry, with education by day-release, block-release, or by the sandwich system. Those who do not enter employment may leave the secondary school, and receive some form of full-time education and training in an establishment of a different kind, that is, in a technical, commercial or agricultural college. In the United Kingdom, full-time courses of this nature (for example, Ordinary National Diploma courses, full-time courses in Radio and Television Servicing, etc.) are offered, for the sixteen-year-old school leaver, in colleges of further education. It is traditional that British secondary schools do not provide courses which are specifically vocational in nature. There are certain advantages in housing such courses in colleges of further education rather than in schools. The main ones are, firstly, that the atmosphere in the colleges is more adult and secondly, that, since the majority of the students in the colleges will be part-time students, mainly day-release, the young full-time students are rubbing shoulders daily with their counterparts who are already trainees within industry.

30 However, in many countries, particularly where it is regarded as normal to remain at school until the age of eighteen, there are secondary school options which may have a strong vocational element, providing courses of education and practical training suitable as an initial stage of preparation, for either craftsman or technician employment. Option for such courses may take place at age fourteen (for a four-year course), or fifteen for a three-year one. Naturally, there is some difference of opinion between countries which offer such courses—and even differences within the same country—concerning the degree of technical specialisation which should be introduced into them. As an indication of the kind of pattern which some countries consider suitable, there is set out below a summary of the programme for a four-year course, the first year being entered at the age of fourteen. The course provides for two main streams namely, the Science, Technology and Trades stream, and the Business and Commerce stream. It also permits a measure of specialisation within these streams.

31 The first year's programme of forty-five periods per week—a period is forty-five minutes—is indicated in Table VIII.

TABLE VIII

First year programme

Subject	Periods
English	7
History	4
Geography	4
Physical Education	4
Mathematics	5
Science	5
Foreign Language	5
Group Guidance	1
Total common	35
Optional subjects	10
Total periods	45

32 For students taking the Business and Commerce option the ten periods devoted to optional subjects consist of five of typewriting and five of business practice. The Science, Technology and Trades students can take ten periods of home economics; or ten periods of vocational art; or ten periods of 'technical subjects': these, in the first year, consist mainly of technical drawing and the elements of workshop practice.

33 The second year programme is similar, except that the foreign language and group guidance periods are replaced with a range of non-technical optional subjects for the Science, Technology and Trades students. These include foreign languages, art, music and commerce. The Business and Commerce students drop science, and have to choose two optional subjects, which may include languages and science. Also, in this year their mathematics classes are separated from those of the other group, the subject being termed commercial mathematics.

34 In the third and fourth years a considerable measure of specialisation develops, and it is necessary to set out the programmes separately. Table IX indicates the scheme for the Business and Commerce students, and Table X the corresponding one for the Science, Technology and Trades students.

TABLE IX

Business and Commerce Programme—third and fourth years

Subjects	Periods
Obligatory	
English (including Correspondence)	7
History and Economics	5
Physical Education	4
Business and Commercial Subjects	19
Total obligatory subjects	35
Optional—any two from:	
Mathematics (Commercial)	10
Science	
Geography	
Foreign language 1	
Foreign language 2	
Art	
Music	
Industrial Art	
Home Economics	
Technical Subject	
TOTAL	45

TABLE X

Science, Technology and Trades Programme—third and fourth years

Subjects	Periods
Obligatory	
English	7
History and Economics	5
Physical Education	4
Mathematics	5
Science	5
Vocational Art *or* Home Economics *or* Technical Subjects	14
Total obligatory subjects	40
Optional—any one from:	
Geography	5
Foreign language 1	
Foreign language 2	
Art	
Music	
Commercial Subjects	
Agriculture	
Vocational Art Home Economics Technical Subject — Other than that option studied as an obligatory subject	
TOTAL	45

Table XI indicates the range of technical subjects offered. The left-hand column indicates the student's primary subject, and the right-hand one the additional technical studies he would be required to follow. A typical time distribution would be five periods per week for the major subject and three periods for each of three related technical subjects.

TABLE XI

Major Technical Subject	Typical Related Technical Subjects
Aircraft Mechanics	Technical Drawing, Workshop Practice, Electricity, Welding.
Air Conditioning and Refrigeration	Technical Drawing, Sheet Metal, Electricity.
Applied Electricity	Technical Drawing, Workshop Practice, Electronics.
Applied Electronics	Technical Drawing, Workshop Practice, Electricity.
Auto Body Repair	Workshop Practice, Welding, Auto Mechanics.
Auto Mechanics	Workshop Practice, Welding, Small Engines, Auto Body Repair, Electricity, Commercial Work.
Drawing—Architectural	Building Construction, Sheet Metal, Plumbing.
Drawing—Electrical	Electricity, Electronics.
Drawing—Mechanical	Workshop Practice, Welding, Electricity, Pattern Making.
Foundry Practice	Workshop Practice, Pattern Making, Technical Drawing.
Industrial Chemistry	Electricity, Technical Drawing.

TABLE XI—*continued*

Major Technical Subject	Typical Related Technical Subjects
Industrial Physics	Workshop Practice, Welding, Technical Drawing, Electronics, Air Conditioning and Refrigeration.
Machine Shop Practice	Technical Drawing, Welding, Pattern Making, Auto Mechanics, Electricity.
Power Plant Operating	Technical Drawing, Auto Mechanics, Electricity, Diesel Mechanics.
Plumbing	Technical Drawing, Building Construction, Welding, Sheet Metal.
Printing	Commercial Art, Photography, Technical Drawing.
Sheet Metal Practice	Technical Drawing, Workshop Practice, Welding, Plumbing, Air Conditioning and Refrigeration.
Welding	Technical Drawing, Workshop Practice, Electricity.
Woodworking—Building Construction.	Architectural Drawing, Sheet Metal, Electricity.
Woodworking—Cabinet Making	Technical Drawing, Sheet Metal, Electricity.
Woodworking—Pattern Making	Technical Drawing, Workshop Practice.
Making and Casting Processes	Foundry Practice.

In addition, students following the Home Economics option may specialise in any one of Food; Clothing and Textiles; or Home Economics (General).

35 It will be seen that such courses may well provide a good background for a number of craft and technician activities. Indeed, apart from a shortfall in respect of technology (practical) some of them may well be regarded as almost reaching a standard appropriate for a junior level of technician. In practice, some students are accepted into employment directly, but may not be paid normal 'skilled man' rates until they have had six months in industry. Others may take a special end-on one-year course of technician education and training, with a strong technology bias. Yet others may proceed direct to the second year of a three-year full-time technician course such as those outlined in Table II and Table IV.

36 It should be noted that these two courses run beside others with a higher academic content but with a similar vocationally biased programme. Successful students on these other courses may progress to engineering or business courses in the University. Transfers between the two kinds of courses are possible at appropriate stages so that pupils sort themselves out as potential craftsmen, technicians or 'professionals' at this stage.

RELATIONS BETWEEN ESTABLISHMENTS

37 The secondary school example just quoted was taken from one of the provinces of Canada, in which country there are colleges set up specifically—and sometimes solely—for the provision of full-time courses at technician level. Whilst some countries are developing separately trade centres for craftsmen, technician colleges and universities, others are faced with the problem of organising post-school provision so as to ensure the most economic use of the expensive facilities needed in each of these areas. Thus these countries may have

to decide whether technician courses should be organized in establishments catering also for craftsmen, or whether they could constitute sub-degree departments in Universities. As in so many matters, the right solution may well be different in different countries, according to circumstances. The pros and cons of the two possibilities are these.

38 The technician—particularly in developing countries—needs to possess, in considerable measure, the same manipulative skills as the corresponding craftsman. Thus a case can be made out for providing courses for technicians in the same establishment as those for craftsmen. The technician would thus acquire an understanding of the abilities and outlook of the craftsman with whom he may have to work closely later. (This arrangement has the advantage, too, that outstanding craft students may be readily transferred to technician courses.) Also it is of great importance to educate the technician in an environment in which he can acquire a pride in his function, which he may well not do if he is trained in a University where he is regarded as an inferior type of student. The point does not arise to the same extent in the craftsman-technician relation, for the craftsman has an established position in his own right, based on a pride in his manual skills. The technician, on the other hand, has no well-established traditions, as yet. He does not, in general, possess the manual skill of the craftsman, and he lacks the academic background of the University-trained man. Thus it is vital to educate him under conditions which develop his standing and his self-esteem. In the United Kingdom, the technician was for many years educated through the medium of a course which endeavoured to provide both technician and professional qualifications. This not only produced a distortion of the curriculum, as far as technician needs were concerned, but resulted, in fact, in only a minority of students reaching the professional level. Thus the image of the technician as the 'failed professional' tended to emerge. Recent developments in courses specifically for technicians will, it is confidently expected, rectify this situation. The lesson to be learned by developing countries from this is that there is much to be said for producing technician curricula which are clearly quite separate and distinct from professional ones: and, where circumstances permit, they should be operated apart from the professional courses. The British experience is that, where one establishment operates at these two different levels, there may be a tendency for a disproportionate amount of the institution's effort and finances to be devoted to the higher level work.

39 As against this, it is a fact that expensive equipment and specialist staff may have to be duplicated if technician and professional courses are separated; and it may be that neither separate provision will then be effectively and economically used. It may, of course, be possible to have some measure of joint use of facilities without the technician course being housed with the professional one, especially if the technician and professional establishments are located suitably.

40 Another factor which may favour locating certain technician courses in Universities is that, although as has been said, many have strong affiliations with corresponding craft courses, there are some technician occupations where the link is much stronger with the related professional level activities. Examples which readily come to mind are medical laboratory technicians; design draughtsmen; technicians in research laboratories, etc.

41 Thus in deciding what arrangement to adopt each country has to consider such factors as geography, numbers needed at each level, and in what occupational categories, as well as the course organisation—full time, sandwich, block-release or part-time day—it will be best to adopt. Indeed, perhaps the best overall arrangement may be to have a trade school, a technician college and a University all on one educational campus, operating as separate entities, but with the common—or at any rate, dual—use of certain facilities and staff.

TRANSFER ARRANGEMENTS FOR STUDENTS

42 Although it is suggested that separate trade, technician and professional centres may be the best organisational arrangement, this need not preclude individual students from moving from one course to another in a different establishment. It may become apparent that a student in the first year of a trade course has abilities which warrant his transfer to a technician course; and, equally, it may be that a first year technician student could be better transferred to a trade course which he will pass, rather than remain in a course which he will fail. Whatever general organisation is adopted, such transfers should be possible. There should, commonly, be two ways to the University. One should be the normal school one, i.e. via the sixth form, if such is the school organisation; but if the country offers junior technician courses, either as a school option or as a post-school course, it should be possible for outstandingly successful students from such courses to enter appropriate University degree courses. This should be the normal route by which outstanding technician students obtain University degrees, namely, by benefiting from the University course itself. The progression from advanced technician to professional status by additional study, such as has been possible in the United Kingdom, is commonly an inferior method, since it usually involves a 'cart before the horse' procedure. A properly designed higher technician course is narrower in its basic mathematical and scientific studies than its University counterpart, and specialises earlier. It also includes more practical technology than does a University course. Thus, for an advanced technician to proceed to a professional qualification necessarily involves going back to certain basic subjects, and studying them more fully. Even so, it is highly desirable that *some* route, however difficult it may be, should be left open for the exceptional higher technician to achieve professional status if he can. The important thing is that the technician course itself should not be distorted in order to bring this about. The advanced technician diploma should be recognised as a qualification in its own right.

43 The fact that the technician course has a lesser content of mathematics and science than its professional counterpart, and that it is more specialised, is the reason for the now admitted failure of a conjoint technician/professional course set up in a European country some years ago. The four-year University programme covers a two-year technician scheme in the first half of the course, the less able students leaving with a Technicians Certificate at this stage. The others proceed for two more years to a degree. This arrangement has, superficially, many attractions. But experience has shown that it suits neither kind of student.

EXTENDED COURSES

44 The increasing tempo of technological progress makes it certain that no initial training, whether at craft, technician or professional level, will suffice for the worker's whole career. Thus the first technician qualification will undoubtedly have to be augmented, perhaps several times in the technician's working life, by means of extended courses. One can distinguish three broad types of extension courses for the qualified technician namely, (*a*) those that raise the level of his existing qualifications; (*b*) those which extend the range of his existing knowledge without raising the level; and (*c*) 'up-dating' courses. The most obvious example of (*a*) is the course which raises the 'technician' to 'advanced technician' level. This may involve some two years on a sandwich or full-time basis or longer by part-time study. Another example might be the course for the advanced electronics technician who takes one of the specialist subjects he has studied earlier to a higher level. He might, for example, take a special course in microwave electronics, or multi-channel radio telephony or a host of others. Yet another case might be the production technician who is sent on a work study course or a course of supervisory studies. Such courses may take place in colleges or in firms, according to subject, and can be anything from a week-end to, say, six months full-time. Examples of (*b*) are obvious enough. Technician courses often provide options in the final year, and it may be that the needs of a particular firm include a broader knowledge than the available course options permit. For example, an electrical technician course may provide electrical power supply) and electrical power (utilisation) as mutually exclusive options. It may be that a particular company may require some of its technicians to be competent at both. The remedy may be to arrange a special course of, perhaps, three months full-time. As for 'up-dating' courses one can hardly indicate any sort of pattern for them. A firm about to install spark erosion equipment may organise a three-day to a week's course on the subject. Another, about to introduce computer control of its machine tools, may need a short course, perhaps with the computer company, for some of its technicians. There are lots of programmes of this type. A very great contribution to the 'up-dating' of technicians is made by technical colleges which put on short full-time courses, or, in centres of industry, part-time day or evening courses over one, two or three terms, on a wide variety of recent developments. In the United Kingdom, for example, many technicians have a reasonable knowledge of lasers, of fuel cells, of magnetohydrodynamics and many other developments well before any practical need for such knowledge has confronted them. This is a good step—although perhaps it hardly equals that of the American organisation which is bringing in technicians from its many outposts to give them a three-months full-time course on developments related to their subject—not developments within the company necessarily. There is no doubt that, in almost all fields of technician endeavour, 'up-dating' courses will play a vital part in the future. It may well be that developing countries will need to send selected technicians overseas for some of them. Also, as candidates may be few and widely scattered, the use of television for such courses should be considered.

RELATION OF COURSES TO EMPLOYMENT

45 In most countries there is a shortage of technicians over a wide range of occupations. There is in consequence a need to plan technician training in such a way that the output from courses matches the countries' needs, occupation by occupation, both in numbers and in terms of the kind of training given. Getting the numbers right is, of course, one aspect of the general manpower planning problem and this has been dealt with in Chapter IV. All that needs to be pointed out here is that, in most industrialised countries the ratio of professional man to technician varies roughly between 1 : 3 and 1 : 5, dependent upon what occupations are involved. Thus, to meet employment needs, one would expect to see roughly four times as much provision being made for technician courses as for corresponding University courses. In hardly any developing countries is this ratio achieved, and there is need to move towards it as fast as conditions permit. One difficulty is that a developing secondary school system which, in its early stages, produces relatively few students at the sixth form (or equivalent) level, finds these students looking towards the University, which often has more places than it can fill. Many students at this level are on the Arts side, and few countries indeed are in the happy position where the proportion of secondary school students orientated towards science, technology, business and agriculture matches the needs of the economy. It may be that one way is to organise more secondary school courses on the lines of the one outlined in paragraph 30. Undoubtedly, too, courses designed to upgrade good craftsmen should be provided.

46 It is most important that courses should be designed with due regard to the needs of industry and business. This implies that programmes should be devised by advisory committees representative both of those who teach the students and those who employ them. It is also desirable that the examinations should be set or otherwise controlled by a similar body. This is a practice which is common to many countries (for example, the United Kingdom and France) and has much to commend it since it ensures that the programme is educationally sound on the one hand and matches the instruction to the functions of the technician on the other. Recent investigations, mainly in European countries, have been made by the Organisation for Economic Co-operation and Development, into the functions which technicians actually perform in industry. These researches also included an assessment of the extent to which the education and training the men had received correlated with the actual technician functions. The researches revealed, not only a divergence of opinion within industry concerning the precise functions of technicians bearing the same title, but, in some cases, considerable discrepancies between what was taught and what the technician subsequently found he needed. These discrepancies are to be expected in occupational areas where technician courses are new, and they serve to underline the need to base courses on job analysis. The investigations also revealed that, in one industry, there might well be large variations in the names given to technicians with corresponding variations in the job analysis. However, these variations often reveal no more than particular requirements of an individual firm. What is needed is to take the analyses of the different technician jobs with similar labels, distil from them the large area of common ground, and ensure that the technology (theory and practical) covers all this. (The programme will also include, of course, the technical education and theory calculated to provide a background to these studies, and a platform for further ones). One cannot hope to include all the techniques required to cover all aspects of a given technician's work, wherever he is employed. Inevitably something must be left to the firm. But a technician who emerges from a full-time course should be in a position where he can confidently expect to tackle most jobs put in front of him: hence the need for basing education and training programmes on job analysis. Finally, not only

should the education be broad enough for both present needs and future development, but the training should be wide enough to stretch a little beyond the boundaries of the job analyses. This is because, in developing countries, where technicians may be few and distances great, the technician may have to turn his hand to tasks related to, but not normally part of, his basic job. The Ordinary and Higher Diploma courses of the City and Guilds of London Institute for students overseas have been designed with this need in mind.

STATUS OF TECHNICIANS

47 The status of the technician is a problem which has beset all countries which recognise the need to recruit good people to technician courses. In most of the advanced industrial countries technicians have, until recently, arrived at their positions by one of two methods. One has been by the upgrading of tradesmen. It is to be hoped that this will, in some measure, continue. But it is a bad thing for the *majority* of a country's technicians to come this way. Not only does it fail to take account of the fact that, in most technician fields a different level of entrant and a different kind of training are required from those appropriate to tradesmen, but it tends to identify the technician's status too closely with that of the craftsman. The second method is even more to be deprecated. It is that of producing technicians by the method of professional failure; that is, by recruiting as technicians those who fail in their University courses. It is obviously a bad thing for any body of workers to be regarded—and to regard themselves—as a collection of failures at something else. A body needs an ethos of its own; and for this reason it is important that the main body of a country's technicians shall consist of people who have *aimed* at becoming technicians, have been selected as having the appropriate qualities, and have been successfully educated and trained. The 'up graded craftsman' and the 'failed professional' should be minority groups in this body to which, if it has the appropriate status, they should be proud to belong.

48 Several countries have realised the importance of achieving a proper status for technicians and have set up for them Associations of Technicians, organised in much the same way as the corresponding professional associations, and having close links with them. Membership of these Associations involves fulfilling certain requirements in relation to technical educational standards, practical training and experience as a technician. In some cases there are different grades of membership according to the technical level reached and the experience gained. Whereas the educational, and perhaps the training requirements will normally be met by success in courses such as have been outlined in this paper, provision is also made for experienced technicians without formal qualifications to sit examinations set by the Associations. Thus the voice of experience may be heard in the proceedings of the Associations, which are not restricted to those who have qualified as technicians by courses which have only recently become available.

49 The Associations conduct meetings, read technical papers, etc., just as do their professional counterparts. On occasions, the technician and the professional bodies may hold joint meetings, at which the contributions from the technicians may well be as valuable as those from their professional colleagues.

50 These Associations, and their links with corresponding professional institutions, are worthy of great encouragement. They will enhance the status of the technician, and thus help to provide an answer to the problem which faces all countries today, namely, how to recruit, train and keep up to date the vast and growing army of technicians without which no nation can hope to expand its industrial, business and agricultural interests and its social services.

APPENDIX

Types of Technician Courses

Administration

- General
- Building Foremanship
- Industrial Production Planner
- Printing Management
- Farm Organisation and Management
- Food Service Supervision
- Transport Administration
- Hotel, Restaurant and Resort Administration
- Cost Clerk
- Merchandising
- Auditor
- Resources Management
- Motor Vehicle Service Manager
- Accountancy
- Work Study
- Secretarial Duties

Aeronautical

- General
- Aircraft Instrument Maintenance
- Aircraft Maintenance
- Aircraft Engine Maintenance

Agricultural

- Field Officer
- Agricultural Engineering

Applied Arts

- Journalism
- Radio and Television
- Photographic
- Interior Decorating
- Furniture and Interior Design
- Home Economics (Clothing)
- Home Economics (Food)
- Home Economics (General)
- Ceramics, Enamelling and Weaving
- Graphic Arts
- Commercial Art, Fine Art, Crafts
- Technical Illustration

Types of Technician Courses—*continued*

Architectural
- General Assistant
- Draughting

Clothing, Footwear and Leather
- Leather Manufacture, Dyeing and Finishing
- Boot and Shoe Manufacture
- Clothing Technology

Chemicals, and Allied Industry
- Chemical (General)
- Petroleum
- Paint Technology
- Plastics
- Industrial
- Industrial Laboratory
- Radio Chemistry
- Textile Chemistry
- Gas Production and Utilisation
- Chemistry and Dyeing
- Photography
- Papermaking
- Printing Ink

Civil Engineering and Building
- General
- Structural Engineering
- Construction
- Concrete Technology
- Land Surveying
- Plumbing Design and Quantities
- Draughting
- Traffic Engineering
- Materials
- Painting and Decorating
- Earth Moving Equipment

Electrical
- Electrical (General)
- Installation
- Illumination
- Technical Sales

Electronic
- General
- Computer Technology
- Marine Electronics
- Instrumentation and Control
- Radar Telecommunication
- Television

Types of Technician Courses—*continued*

Food

Breadmaking and Flour Confectionery
Commercial Cooking
Milk Processing and Control

Forestry

General

Mechanical

General
Draughtsman
Marine Engineering
Heavy Duty Equipment
Power Plant
Machine Shop Engineering
Tool Making
Pattern Making
Quality Control
Metallurgy
Technical Sales
Foundry
Welding
Metallurgical
Planning, Estimating and Costing
Steelwork Fabrication, Heating and Ventilating
Industrial Control
Sheet Metal
Instrument Production
Refrigeration and Air Conditioning

Medical

Medical Laboratory
Nursery Nursing
X-ray
Health Inspection
Dental
Radiography

Mining

Colliery Mechanics
Colliery Electricians
Coal Mining
Iron Ore Quarrying
Sand and Gravel Quarrying

Miscellaneous

Navigation
Technical Writing
Computing
Data Processing

Types of Technician Courses—*continued*

Printing and Paper

- Paper and Board Making
- Typographic Design
- Printing Processes
- Printer's Costing and Estimating

Shipbuilding

- General
- Shipbuilding Draughtsman

Textiles

- Wool (Raw Materials)
- Mill Engineering
- Woollen Yarn Manufacture
- Woollen and Worsted Weaving
- Worsted Spinning
- Cotton Weaving
- Cotton Spinning
- Flax
- Linen
- Jute
- Silk and Man-Made Fibres
- Hosiery and Knitted Goods

Vehicles

- Vehicle Body Work
- Motor Vehicle (General)
- Diesel Vehicles (General)
- Vehicle Sales
- Draughtsman

Wood and Furniture

- Machine Woodworking
- Furniture Design and Manufacture
- Furniture Production
- Furniture Materials

Report of Working Group A(2)—Types, Content and Organisation of Courses

Chairman: Dr. C. R. Ford (Canada)

INTRODUCTION

1 The Working Group agreed that emphasis should be placed on the development of balanced programmes of technician training, which included appropriate general education as suggested in the lead paper presented by Dr. French. The term 'general studies' was preferred to the term 'liberal studies' because of the implication that technical studies were illiberal.

TYPES OF COURSES

2 The range of technician courses extends from the near-professional at one extreme to the near-craftsman at the other. The content of courses, within this range, in a technical field includes elements of:

(1) Technical theory—mathematics, sciences, or other subjects relevant to the techniques required by the technician.
(2) Technological theory—relevant to the equipment and specialised techniques which must be used.
(3) Technical and Technological skills—all skills of which the technician must have mastery, whether manipulative, conceptual, evaluative or of judgement, such as manual, measurement or application of background theory.
(4) General Education—including studies designed to broaden social, cultural or occupational understandings and competencies, although there is a continuous range of technical competencies extending from above the craftsman to near the professional or technologist.

3 The difference between the kinds of technician courses in an occupational field is chiefly a difference in the mix of the elements: the near-professional being characterised by a higher content of technical and technological theory, and a smaller percentage of operative skills, than the near-craftsman courses.

4 The range of types of technician also includes what might be termed a 'horizontal' dimension which embraces the whole spectrum of occupations, such as engineering, agriculture, fishing, forestry, mining, manufacturing, construction, business and commerce, medical health, service occupations, etc. Different requirements and specifications for technician courses are to be found in different countries or occupations, depending upon the needs of the country or the occupation. Each technician course for each kind of technician must have its own integrity; it should not be planned as a continuous progression leading to technological or professional qualifications although provision must always be made for the more able student to proceed to more advanced levels.

CONTENT OF COURSES

5 The objective of all technician courses should be the development of occupational competence, and course content must be based on an analysis of

the work of the technician. There is an urgent need for a comprehensive analysis of a total industry to identify the work or function of the technician. Such an analysis should provide a clear distinction between the functions of the technician on the one hand, and the technologist and the craftsman on the other. The functional analysis contained in the lead paper presented by Dr. French provides an example of a basic analysis of the functions of a total industry at the levels of technologist, technician, craftsman and operative. With the functions of the technician identified, there is a necessity for a further detailed analysis in order to identify each element or operation of the technician's function and the related technical information or technological knowledge required to develop the degree and kind of occupational competence required.

6 There is a difficulty in obtaining from industry information about technological and other changes which should be reflected in training courses. The establishment of courses on a sound scientific basis, however, will make technological changes less difficult to accommodate. For example, some countries may have a sudden training need in a previously unfamiliar field of technology, such as nuclear technology or hydrology. These being applications of basic scientific principles, assimilation should be possible provided basic scientific principles are an element of appropriate stages of instruction.

7 The development of curricula or courses of study following the occupational analyses is an important and difficult step. Although advisory committees and representatives of the occupational field or the industry should be retained and must participate in this exercise, it is essential that the teachers assume a responsible role in co-ordinating this work. The Group considered it undesirable that curricula be established solely for examination purposes, and re-emphasised the basic purpose of all courses.

8 The detailed teaching syllabus in each subject should be prepared by the teachers concerned, whenever feasible. However, there is a need on the part of indigenous teachers in some countries for detailed teaching syllabuses in each subject and the preparation of such materials by a responsible agency in co-operation with the teachers is recommended.

9 The Group noted the relative similarity of the time distribution for theoretical or practical studies suggested for full-time courses in engineering technologies by three different countries. Different time requirements for the subjects of a course may be necessary in developing countries, and for part-time or day-release courses.

10 General educational studies should be an integral part of all technician training programmes. However, this element must not be construed as remedial but as general, with the objective of contributing to social and occupational competencies. The dual nature of English (*a*) as a technical subject and (*b*) as a communication skill, was emphasised. Special subjects, such as supervisory training, may be regarded more properly as a part of technical training, and are frequently of a type requiring special treatment which might be given subsequent to the main course.

11 The seemingly endless proliferation and fragmentation of technician courses and the identification of some craft courses as being at technician level is

viewed with alarm. Frequently such fragmentation results from an inadequate analysis of work functions of the industry, of the occupational field or of the work of the technician.

ORGANISATION OF COURSES

12 Several organisational patterns, with their variations, were briefly reviewed, such as:

(i) Full-time integrated day;
(ii) Sandwich;
(iii) Block-release;
(iv) Part-time—(a) day-release
  (b) before or after hours of work
  (c) during hours of work;
(v) Correspondence;
(vi) Accelerated courses;
(vii) Refresher and Upgrading courses.

These are outlined in detail in Dr. French's lead paper. The Group commented upon the various patterns as follows:

FULL-TIME INTEGRATED COURSES

13 These courses constitute the basic pattern in many countries, and the consensus was that this type of organisation has many advantages and relatively few disadvantages.

Advantages:

(a) Complete integration of theoretical and practical training under control of the institutes.
(b) The purpose of practical or laboratory work is instructional rather than production.
(c) Ease of developing standards.
(d) More efficient and effective.
(e) Can be provided irrespective of employment conditions or availability of employment in local industry.

Disadvantages:

(a) The industrial atmosphere is not present.
(b) Colleges tend to follow technological change at some distance and are not up-to-date.
(c) Colleges may lose contact with the requirements of the industry or occupation for which instruction is given.

SANDWICH COURSES

14 This type of organisation is particularly effective where industry participates in the spirit of the training. Several patterns for sandwich courses were identified, e.g. six months in college and six months in industry; four weeks in college and eight weeks in industry; six weeks in college and ten weeks in industry.

15 In several countries no courses are organised on the sandwich pattern, although in principle their effectiveness is recognised. There may be valid economic reasons for this, e.g. where few firms have sufficient workers to permit release of technicians or where distance prohibits such part-time attendance at college.

BLOCK-RELEASE

16 This type of organisation is reported to be more effective than day-release. Its success, however, depends to a great extent on the co-operation of employers and this is, in general, more readily forthcoming from employers of large numbers of workers. Such courses must be tailored to the needs of industry and longer blocks of training were reported as more effective than more numerous short courses. The Group repeatedly emphasised the necessity for information about the relative merits of the different types of organisation.

PART-TIME

17 (*a*) *Day-Release.*

This pattern is considered to be suitable only in relatively large industries in urban centres. It is much less widely dispersed than most other types of organisation. The release of the worker for two days per week was claimed to be much more effective than one day per week.

(*b*) *Before or After Working Hours* (*Evening Classes*)

The Group was unanimous in the view that evening classes only are an undesirable device for training a country's technician manpower and should be avoided when other types of organisation can be arranged. Part-time classes of this kind, however, will always be required and should be provided for persons who are unable to attend other classes.

(*c*) *During Working Hours*

A recent development of part-time training was favourably commented upon. In this pattern the training is given during the last hours of each working day and continued for approximately an equal period of the worker's own time. This device has had the enthusiastic support of both workers and employers.

CORRESPONDENCE COURSES

18 These form a considerable element of technician training in Australia and New Zealand. It is important that in these courses opportunity should be given for students to meet and exchange ideas with their tutors; a feature of these courses is block attendance by students at various times during their course. There is little evidence of wastage (drop out) in Australia, New Zealand or in the recently developed courses run by the National Extension College in the United Kingdom. In developing countries where English is a second language, there need be no real difficulty at technician level in correspondence courses, provided that tutorials and block attendance form part of the course. It may be possible for instruction by radio to be used to reinforce correspondence courses. It is, however, emphasised that correspondence courses are only a second-best device as a means of providing instruction at technician level.

ACCELERATED COURSES

19 Developing countries are understandably in a hurry to train their technicians. There is nothing fixed about the number of hours required to teach a course. If modern teaching aids prove effective in speeding up the learning process, the duration of the course can be shortened accordingly.

20 Sometimes there is an urgent demand for technicians to meet an emergency. Every effort should be made to meet the emergency by means of *ad hoc* courses but these should not become the accepted courses if speed was achieved by omitting essential facets of the normal training. Trainees who followed such a course should be given a special form of certificate which could later be up-graded to the normal certificate by successful completion of an additional course.

REFRESHER AND UPGRADING COURSES

21 The Group recognised the importance of courses designed to aid the upgrading of technicians, and those concerned with ensuring that the technician's knowledge is up-to-date. Courses of this type were seen as an important element of the technician training programme.

INDUSTRIAL EXPERIENCE

22 There is a partnership between industry and education in the training of technicians. Goodwill and forbearance are required on both sides as is a recognition of the other's point of view. In the case of students on sandwich courses, supervision of the apprentice on the job is a desirable feature and one which requires full co-operation between employers and Principals of colleges; it is not desirable that Principals of colleges should be expected to organise or assume responsibility for industrial experience for their technician students.

23 The Group discussed at some length the different patterns of part-time instruction and the claims made on behalf of the quality provided by each. It was felt that, whilst each pattern undoubtedly had merits, claims were being made on the basis of inadequate research.

24 It is strongly recommended that research should be undertaken to determine the relative effectiveness of part-time, block-release and sandwich courses for technician training.

Discussion of Report in Plenary Session

The importance of properly planned industrial experience as a vital and integral part of technician education and training was emphasised by the Chairman of the Working Group when introducing the report. The difficulties of ensuring adequate and appropriate industrial training vary according to the type of course (full-time, sandwich, block-release or day-release) but in all circumstances it is essential, if satisfactory arrangements are to be made, for the closest possible collaboration and co-operation between educational institutions and industry and commerce.

There was considerable discussion on the question of whose responsibility it is to see that adequate industrial training is provided. In the case of full-time courses it is clearly the responsibility of the Principal and staff of the educational institution; in the case of day-release classes it is equally clear that the educational establishment is in no position to supervise and assume responsibility for the work done in industry or commerce during the remainder of the week. Block-release and sandwich courses raise particular difficulties: on the one hand, the Principal of an educational establishment cannot be expected to be responsible for work done outside his control; yet, on the other hand, the periods spent in industry or commerce can be considered as part of the course which is being offered by the educational institution and therefore, the Principal should be responsible for the adequacy of the industrial training. Much depends upon the organisation of particular courses and upon the degree of collaboration existing between the college and the industrial and commercial firms concerned.

It was generally agreed that the content of technician courses, especially in the early stages, should be broad so as to provide a basis for subsequent specialisation and to assist adaptability. This will also inhibit the excessive fragmentation of courses into narrow specialisms.

The possibility of crash programmes and accelerated courses was discussed at some length in the context of the time required to train and educate a technician. It was accepted that there may be a need for an accelerated course in order to meet an urgent demand for a particular type of specialist skill although it was suggested that, if the skill required was really so limited, the work involved was more likely to be that of a skilled operative not a technician. The suggestion was made that these accelerated courses should not necessarily lead to a full technician qualification, which might require further training and education at a later stage. Considerable importance was attached to the maintenance of proper standards and to the danger of sacrificing standards in the interests of speed. It was generally thought that more research is required to find out the real time required to train technicians.

There is a need for research into the various types of part-time courses in order to determine their relative merits. The general view was that evening classes are the most unsatisfactory form of education but delegates accepted that they are probably unavoidable at this stage in that they are required to meet a need which cannot be satisfied in any other way. There was general agreement on the desirability of continuation or refresher courses being available for technicians, and for technical teachers, throughout their careers.

CHAPTER VI

The Planning and Equipping of Institutions, including the Provision of Libraries, Textbooks, Audio-Visual Aids, etc.

Lead paper presented by Mr. R. E. Dunbar, Director,
Department of Technical Education,
New South Wales, Sydney, Australia

1 The subject on which I have been asked to speak is not only in itself a very broad one, but one that is also inevitably bound up and interrelated with a vast number of educational questions, representing almost every aspect of educational theory and practice. Since the overall aim in planning and equipping an educational institution is to provide the most effective physical or material means possible for implementing a particular educational programme, the range of questions demanding some consideration extends from the widest educational issues, such as the relative effectiveness of large group instruction, to minor problems such as those associated with the location and use of a particular piece of equipment in a particular workshop or laboratory.

2 In a short paper such as this, one obviously cannot cover all aspects of the planning and equipping of an institution for the education and training of technicians. I shall be concerned mainly with some general principles and with some of the kinds of problems likely to be met. There are some aspects of the planning, however, with which I shall deal more specifically, although my treatment of these will necessarily be rather restricted. An outline of the procedures to be followed in the planning is appended to this paper (Appendix A).

3 On the detailed planning and equipping of an educational institution there is a mass of useful material available. I shall make particular reference to some of this later. I have included among the appendices to this paper a short list of publications dealing with the subject (Appendix B).

Some essential preliminary requirements

4 At the outset it cannot be stated too emphatically that the initial approach to the planning can establish the entire project on a sound basis or it can create serious and perhaps permanent difficulties. Before effective planning can be started, several requirements are essential.

5 A comprehensive assessment should be made of the manpower needs and demands for technicians in the region the institution is to serve.

6 The educational aims of the institution should be set out in detail following consideration of:

(i) the types of technicians to be educated and trained, and the estimated initial and annual intakes of each type,

(ii) the number of prospective students with the minimum educational, and other required entrance qualifications, and

(iii) the pattern of attendance to be adopted for the courses, e.g., full-time, part-time, block-release.

7 The need for accurate and adequate economic, manpower and educational data, and methods of assessing educational and training requirements have been considered in an earlier paper, and I do not intend to discuss them here. When these requirements have been determined it is necessary to prepare a detailed schedule of courses. The structure and subject syllabuses of each course should be developed in sufficient detail to enable an estimate to be made of the teaching hours required for each subject. The schedule of courses provides the basic data for the schedule of teaching accommodation, and I shall refer to it again later. There are, however, several other factors, and some related questions, affecting the type and range of accommodation required for a particular technical institution which must be considered before the preparation of the schedule of accommodation is attempted.

The type of institution

8 One question, having far-reaching implications for the planning and equipping of the required accommodation, is whether the training of technicians is to be carried out in a separate institution, or within one providing training for various occupational groups at different academic and technical levels. It must be recognised that the type of institution to be provided in a particular area is dictated almost entirely by 'external' factors. These include the general level of industrialisation in the area to be served, the overall manpower needs, the nature of existing educational institutions, and similar factors which need not be considered here, but whose importance should not be overlooked. Only in highly industrialised areas is it possible to maintain separate institutions for technician training.

9 The most common development is from an initial multi-level institution to separate, more specialised institutions, each offering training within a restricted range of levels. This certainly is the most economical way of providing a state system of technical education that is able to adapt to, and grow with, the ever-increasing training needs of a developing economy.

10 Besides allowing maximum utilisation of buildings, equipment and staff, the provision of different levels of training in the one institution makes it possible to have better accommodation and facilities than could be obtained if resources were spread through several institutions. A particular advantage for technician training is that appropriate facilities and environment are provided for both the 'advanced trade' type of technician training and the more strictly sub-professional type of training.

11 There is a danger in multi-level institutions—though by no means confined to them—that courses originally designed for training at one level may have their distinctive character changed to the detriment of their function to provide easier escalation to higher level courses, or, less excusably, for strictly economic or administrative reasons. There are also possible dangers for student morale—students at the different levels may find it very difficult to establish and maintain

an appropriate group identity; if unnecessarily heavy lines of demarcation are drawn those affected most adversely are the students at the lower academic levels who, of all students, usually require most encouragement in their studies.

12 When all factors are taken into account there is little doubt that the advantages of establishing technician courses initially in a multi-level institution far outweigh the disadvantages. In the preliminary planning of such an institution every opportunity for deriving maximum advantage, with respect to efficiency as well as economy, should be fully explored and acted upon.

Location and site; some implications for training

13 Location and site are most important; they may contribute to, or limit, the effectiveness of the institution throughout its existence. If a site has already been provided for the institution, the planning should ensure that it is used to the best possible advantage. If the location and site are to be selected, every effort should be made to obtain the most suitable available.

14 In addition to the basic requirements, such as accessibility and adequate water, power and fuel supplies, which the location of any institution providing technician training must satisfy, due regard must be given to the special requirements dictated by the nature of the institution.

15 In this connection there are three main types of institutions providing technician training. These are:

- (i) colleges conducting courses in various branches of engineering, science and commerce in areas where the population is concentrated and where most of the students are able to attend courses without requiring residential accommodation,
- (ii) colleges at which most of those taking courses in engineering, science or commerce are full-time students who require residential accommodation, and
- (iii) colleges providing agricultural courses on a full-time basis and having students in residence.

16 The first type of institution should be located either in close proximity to the industries for which it is training students or within easy access of the students' homes, and in an area well served by public transport. In a highly developed urban area there are advantages in having the institution, particularly one offering part-time and evening courses, close to the students' homes. If, because of insufficient numbers of students or lack of facilities, it is not possible to provide complete courses at the local institution, there is still much to be gained by offering the early stages of the courses locally. A number of local institutions can then serve as 'feeder colleges' to a central institution at which the students may take the later stages of their courses.

17 The second type of institution should also be located near enough to an industrial centre to allow for close and continuing liaison and co-operation with industry and commerce. This is particularly important where qualified specialists from industry are required to serve as part-time teachers at the institution.

18 While a large site has obvious advantages for agricultural training, if it is put to extensive use the employment of farm labour becomes an important factor in the management of the institution. There is a danger that production will take precedence over training, and that students will be required to do excessive routine work that has little educational value.

19 An agricultural college can function satisfactorily on a more restricted site if some of the practical and experimental work can be done on nearby farms. Where a small site in an urban area has to be used, effective training can be given if the college work is supplemented by practical sessions at a rural college, or by other outside field work.

20 There is no simple formula for determining the appropriate area for the site of a particular technical institution. Comprehensive surveys of the area which the institution is to serve will provide basic data on present and anticipated future training needs, and this can be supplemented by information obtained from a study of the sites of existing institutions.[1] Information of this kind is published regularly in a number of educational and architectural journals, several of which are listed in the bibliography appended to this paper (Appendix B).

21 For any kind of educational institution, it is usually good practice to select a site that is larger than the estimated necessary area. This generally proves to be more economical in the long run. The extension of an established site, particularly in a city or suburban area, is not always practicable. Where it is, the cost is likely to be prohibitive, especially when it involves the purchase and demolition of adjoining buildings. The conversion of adjoining buildings for training purposes is also usually very costly, and is seldom entirely satisfactory. Nor is the provision of a second, supplementary site likely to be satisfactory, unless it is very close to the main site. Divided sites can create serious administrative problems, as well as cause considerable inconvenience to students and staff.

22 In addition to the more obvious economic factors influencing the selection of a site, such as its initial cost and suitability for economic building development, the question of likely subsequent expenditure should be carefully considered. The advantage of a site that would involve heavy expenditure on maintenance and grounds development must be weighed against the probability of less finance being available for strictly educational purposes.

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[1] In New South Wales it has been found that an area of about 12 acres is necessary for a metropolitan or suburban technical college providing a fairly wide range of courses, including trade and technician courses, and serving a student population of up to 8,000, most of whom attend part-time. At most of these colleges about one-quarter of the students—mainly those in trade courses—attend one full day each week. More than half—including those in technician courses—attend on two or three evenings per week, and in many cases for one half-day each week in addition. A small proportion—normally less than 10 per cent—are full-time students. This area is sufficient to cater for all the educational needs and for a variety of extra-curricular activities. It does not include residential areas or playing fields.

The two major agricultural colleges in New South Wales, which are residential, are located in rural areas, and each has a site of more than 3,000 acres. These areas allow for a wide range of farming and related practical activities and the carrying out of an extensive agricultural research programme. A brief statement on agricultural training in New South Wales is appended to this paper (Appendix C).

23 Since it is generally difficult—and often impossible—to overcome the disadvantages of an unsuitable location or an inadequate site, the need for thorough investigation and careful selection of location and site cannot be over-emphasised. The selection of good location and site is a major contribution to the future effectiveness of the institution.

The need for forward planning

24 The problems associated with the selection of a suitable site can be minimised by a policy of forward planning. Needs can be anticipated and suitable land acquired some years ahead, so that the planning, the provision of basic services and any other preliminary development work can be completed by the time the buildings are required.[1]

The importance of accurate prediction of educational requirements and use of available information on similar institutions

25 I have emphasised the fact that the effectiveness of the planning of the institution depends very largely upon the accuracy of the initial assessment of the educational and training needs and demands to be met. Even when comprehensive data on manpower needs and student potential are available, the prediction of educational and training requirements can be a difficult operation. Where they are not available an attempt must still be made to predict as accurately as possible. In either case, it is essential that all available relevant data are utilised, and that the best possible methods and most reliable tools of prediction are used.

26 Plans based on such prediction must take into account the time-lapse, possibly of two or three years, between the initial planning and the occupancy of the institution's buildings. The plans may have to include the use of temporary accommodation, in which case the possibility of using the facilities of an existing educational institution should be given first consideration.

27 Whatever type of institution is proposed for a particular area, it will be found that similar needs and problems have been, or are being, experienced elsewhere. Much time and effort can be saved by obtaining information on similar building projects, and in particular on recent attempts to find more satisfactory solutions to the many problems involved. Full use should be made of the published material, to which I have already referred, covering almost every aspect of the planning and equipping of a technical institution. The practical experience of teaching and other staff associated with the planning should also be drawn upon. This can be an extremely useful source of information and suggestion, and should be fully utilised.

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[1] The practice adopted by the New South Wales Department of Technical Education provides an example of forward planning. Requirements with respect to sites for technical colleges are planned for periods up to 10 years ahead. Investigations are carried out in areas where it is thought likely that a new college will soon be required; comprehensive and detailed information is obtained on local population and industries, on plans for future development, and on present and likely future training needs and student demands. Assistance is given in these investigations by district advisory committees serving existing technical colleges in an adjacent area or surrounding district. Where the need for a college is established, a number of possible sites are inspected by technical education authorities and an architect, and on their recommendation a site is acquired. The planning of the college can then be commenced at any time, depending on the urgency of the need for training in the area.

The purpose of the buildings

28 That the aim from the earliest stage of preliminary planning should be to obtain for the institution buildings that are functional, economic, flexible and æsthetically pleasing is a proposition that would, I imagine, be accepted by all concerned. But when the respective merits and competing claims of these qualities come to be considered with respect to a particular building programme, inevitably there are differences of opinion.

29 In a characteristically provocative address, given at a symposium on the design of teaching laboratories, held in London in 1958, Sir Eric Asbby said—

> 'The purpose of university buildings is not primarily to ornament the landscape; it is to keep members of the society, together with their books and equipment, warm, dry and adequately illuminated. Therefore when a university asks an architect to design a chemistry building, it expects the architect to work from the inside outwards. If the architect can make the building beautiful, so much the better; it is his responsibility to do his best to achieve beauty. But the *purpose* of a chemistry building is to suit the convenience of the society that works inside it, not to elicit the admiration of people waiting at the bus stop on the other side of the road.'[1]

30 There is much good sense in this view. I particularly like the reference to the need 'to work from the inside outwards'. It is not only the architect who needs to keep this phrase in mind; it should serve as a guide to all concerned with the planning of a technical institution.

31 To argue that the first essential requirement of an educational building is that it should serve its educational purpose is not to deny the importance of the other qualities to which I have referred—economy, flexibility, and æsthetic appeal.

32 The claims of economy are such that it is generally assured a high priority in an educational building programme. At all stages and in all areas of planning, economy must, of course, be given due consideration. But economy is a relative concept; in an educational planning project it should be considered in relation to all other significant factors, and in particular to the need for maximum educational efficiency.

33 The special nature of technical education and its relationship to scientific and technological development demand that planning should aim at buildings which can, with minimum expense and least interruption of training, be adapted to fulfil changed functions and serve new purposes. For technician training, in particular, a high degree of flexibility in buildings is essential. As the rate of scientific and technological development continues to increase, its effect, and demands, on technician training must continue to grow. Furthermore, the specialised training of technicians, itself a recent development, is, more than most areas of education, subject to change—in subject matter to be taught, in teaching methods and in the equipment and materials used.

34 The provision of buildings that are æsthetically pleasing is in a sense part of the educational process. To design such buildings is the responsibility of the

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[1] Royal Institute of British Architects. Teaching laboratories, report of a symposium on design of teaching laboratories in Universities and Colleges of Advanced Technology. London, R.I.B.A., 1958.

architect. He can be greatly assisted in his task if all concerned in the planning of the institution keep before them the ideal of creating an environment that will offer the best possible conditions for imparting the knowledge and developing the skills proper to the student's vocational interests, and for giving the wider educational experience necessary for the student's personal and social development.

Preparation of the schedule of accommodation

35 This is a complex project calling for expert knowledge in many areas and close and continuing co-operation between the teaching and administrative staff planning the institution. The architect should be brought into the discussions before the schedule is completed. This enables him to acquire necessary information regarding the activities for which the accommodation is being planned and to suggest ways in which it might be arranged more economically or efficiently.

36 Concerning the procedure to be followed in preparing the schedule of accommodation, the form of the schedule, and recommended areas for the various types and units of accommodation required, the Ministry of Education 'Building Bulletin No. 5' [1] gives detailed directions and extremely useful information. I shall not attempt to treat in detail these matters so well covered in the Bulletin.[2]

37 It may be useful, however, to give a very brief outline of the procedure usually adopted in preparing a schedule of accommodation:

(i) The teaching accommodation schedule is first prepared. This is based on the schedule of courses and involves a detailed examination of the requirements for each subject proposed, and for each class within each course.

(ii) An estimate of the maximum student capacity of the teaching accommodation is made, and on the basis of this estimate the required administrative, and communal and recreational accommodation is determined.

(iii) The residential accommodation requirements are then determined. This accommodation is considered in relation to the provision of the communal and recreational accommodation. The number of residential places and the form of accommodation—e.g. hostel or residential college—to be provided for students in full-time courses, and if necessary for those attending for part of the academic year, must be worked out in detail, and the accommodation required for teaching, administrative and other staff determined.

38 The schedule of accommodation does not include the requirements for circulation and ancillary accommodation; the latter comprises cloakrooms, toilets, cleaners' store rooms etc. It is usual for the architect to provide for the circulation and ancillary accommodation. For this purpose he allows a proportion—from a quarter to a third—of the total area provided for the other accommodation.

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[1] GREAT BRITAIN. Ministry of Education. New Colleges of Further Education; 3rd ed., London, H.M.S.O., 1959. (Building Bulletin No. 5.)

[2] A schedule of accommodation for a science block at Granville Technical College, New South Wales, and a table of recommended areas for certain types of accommodation are appended to this paper (Appendices D and E). *Note: Mr. Dunbar also appended related drawings and functional layouts: it is regretted that these could not be reproduced in this Report.*

39 Three points need particular emphasis:

(i) Sufficient time must be allowed for the schedule of accommodation to be prepared carefully and accurately. The initial statement of requirements obviously has a direct and important bearing on the efficient functioning of the institution and on its future development.

(ii) If possible, the schedule of accommodation should set out the requirements for the entire building project, even though it will be realised that some changes may be necessary before the whole project has been completed. It is essential, of course, that the extent of the building works to be undertaken immediately be determined before the schedule is prepared. Comparative costs of constructing part of a building or a complete building should be closely examined; building by stages generally increases costs.

(iii) If the project is to be carried out in stages, the schedule of accommodation must ensure that the first stage will be able to function efficiently as an independent educational unit, and also fit naturally and effectively with later stages, and within the whole project.

Teaching accommodation

40 The planning of the teaching accommodation can be undertaken only after a close study has been made of the subject matter to be taught, the levels of instruction required and the numbers of students to be trained. The data derived from such a study should indicate clearly the *range of accommodation* to be provided. But the planning must also be closely related to the *teaching methods* to be employed and the *staffing arrangements* proposed. It thus involves consideration of some of the wider issues of educational theory and practice, and inevitably reflects, in varying degrees, the educational thinking and preferences of those concerned. The provision of an expensively equipped laboratory for a specific teaching purpose implies the belief that the purpose cannot be achieved as effectively by other, more economical means. When planning teaching accommodation, then one should be reasonably confident that the educational practices and methods for which the accommodation is being arranged are the most effective available.

41 We are only at the beginning of a period in which many of the long-established teaching practices and methods will be re-examined, and either modified or replaced by newer, more efficient practices and methods. So far as possible, the planning of the teaching accommodation should provide for experiment and innovation in teaching, and in particular should allow for greatly increased use of the rapidly developing range of teaching aids.

42 The use and development of a variety of teaching aids are bringing about fundamental changes in the nature of the teaching accommodation required. While the full extent of these changes cannot be predicted, even for a few years ahead, the planning of the accommodation should take into account present achievements and trends, and should show an awareness of future possibilities. This means, for example, that all lecture theatres, and as many classrooms as possible, should be designed and equipped for the use of the various types of optical projectors; unless rear projection equipment is to be installed the rooms should be able to be darkened and ready for use at a moment's notice. Where large group instruction is to be given, or small-scale demonstration work is

required, provision should be made for the use of closed-circuit television, with sufficient monitors, where necessary, to give all students a close view of programmes. Special purpose accommodation, such as sound-proofed rooms and carrels for programmed instruction, and language laboratories, should be carefully planned, and provision made for the future expansion of this type of accommodation.

43 The difficulty of obtaining suitable teaching aid material for many areas of technician training is well known; it is most important that accommodation be either specially provided or made available for staff to plan and produce some of the teaching aids required for use in the institution. Basic accommodation should include a photographic studio, film processing, developing and printing rooms, a theatrette, a drawing office and a general purpose workshop.[1]

44 All types of teaching accommodation—lecture theatres, classrooms, laboratories, workshops, drawing rooms, libraries, tutorial and special purpose rooms—should be so arranged that they can be utilised as fully as possible. Where practicable, the accommodation should be planned to serve more than one purpose—always provided it can do this effectively.

45 Means of providing appropriate accommodation to meet special training requirements should be carefully examined. In areas where students cannot obtain suitable practical experience in industry while undertaking their course, various ways of creating the conditions that will give appropriate 'work experience' within the institution must be considered. Where students recruited to technician training have widely differing educational or occupational backgrounds, careful thought must be given to planning workshop or laboratory accommodation that will permit any necessary variations from the normal training programme.

46 An orderly and economic approach to the planning of accommodation is ensured if it is based on a convenient unit area, or planning module, for example 4 ft × 4 ft squares. The use of this method does not mean that the one module must be adopted consistently throughout the planning of all the teaching accommodation; different modules may be required for different buildings, or for different types of accommodation in the same building.

Laboratories

47 Of all teaching accommodation, laboratories usually present the most difficult planning problems. They are normally the highest cost areas, per square foot, and often the least used. Because of the special concern of technicians with the application of scientific principles and the development of techniques, laboratory work provides a large and characteristic part of their training. For these reasons, every detail of this area of planning should be given the closest attention, particularly by those directly responsible for the education and training of technicians.

48 Flexibility is the keynote in laboratory planning. Whatever purpose it is intended to serve, a teaching laboratory must be adaptable to change. While it

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[1] Further reference to the need to prepare teaching aids within the institution is made in the section of this paper headed 'Textbooks, programmed instruction, audio-visual aids'. (See paragraphs 84–91.)

is not always possible to predict the kinds of changes that will be necessary, even in the near future, in a particular laboratory, the need for change, including the extension of laboratory facilities, can be anticipated and to some extent provided for in the initial planning. Good planning will ensure that any required changes can be carried out economically and with minimum interruption to the normal laboratory work.

49 The degree of flexibility desirable—or possible—in a laboratory depends mainly, of course, on its intended purposes and functions. A laboratory used for teaching basic principles to junior students is less likely to require significant changes than one designed for advanced or specialist work in a field in which rapid technical advances are being made. It must be recognised, however, that the purposes and functions of laboratories are themselves liable to change, particularly in those areas of technician training in which scientific and technological development is quickly followed by the introduction of new industrial processes and techniques.

50 Maximum internal flexibility within a laboratory can be achieved by the thoughtful planning and use of moveable elements. Careful consideration should be given, for example, to the possibility of using moveable and interchangeable walls and partitions; these can be designed to support equipment and service connections, if necessary. Possible uses of mobile tables and demonstration equipment should be examined; these allow for many time-saving as well as space-saving innovations and can reduce considerably the amount of teaching time lost in setting up apparatus and equipment. Some of the moveable elements used in laboratories, however, are very expensive, and the urge to introduce elaborate mobile devices that have high prestige value but limited usefulness must, of course, be resisted.

51 As far as possible, laboratories serving similar purposes should be grouped, both for economic reasons and the convenience of staff and students. The laboratories should provide direct access to store rooms and also to a teacher's room, where, for example, samples can be issued to students or their work results checked.

52 Where a large number of laboratories are required within a department or school it is essential that a small workshop be available, providing facilities for the testing and repair of equipment and for ancillary work such as chart or model making.

53 Much of the detailed planning of the laboratories must be considered along with questions concerning the structural design of the buildings, and therefore in consultation with the architect. If the main service ducts, for example, are required to run horizontally beneath the floor the structural design should preferably avoid the use of deep beams and girders.

54 Special attention should be given to the suitability of materials proposed for laboratory finishes and fittings. Before a new material is used its composition and properties, and its performance under conditions similar to those existing in the laboratory, should be carefully examined.

55 The problem of under-utilisation of laboratory accommodation seems to be universal. Some of its adverse practical effects can be eliminated, or at least diminished, by the careful planning of multi-purpose laboratories and co-ordination of the programme of laboratory work.

56 A word of caution is appropriate here. While there is a tendency nowadays to break down, or even refuse to recognise, the former 'borders' between the branches of certain disciplines, particularly in the physical sciences, it does not necessarily follow that it is appropriate to *teach* the various branches in the one laboratory. There are serious difficulties, for example, in trying to teach both chemistry and laboratory techniques in the same laboratory to even second-year science technician students. For a laboratory to be suitable for this dual purpose it should possess the combined characteristics of an inorganic and a junior analytical laboratory, as well as serve as an organic laboratory. It is most unlikely that dual or multi-purpose laboratories can provide effective teaching in the later stages of a technician course, or for advanced or specialist work.

57 The question whether common laboratory and workshop accommodation can be used effectively for both the 'advanced trade' type of technician training and specialist technician training can be answered only in relation to particular groups of students in particular courses. A compromise must be reached between providing the special accommodation to meet the different training requirements and avoiding unnecessary duplication of accommodation and facilities.

Libraries

58. I think it is generally accepted that in the education and training of technicians too little regard is paid to the contribution that libraries can make. Broadly stated, the main function of a library in a technical institution is to support the teaching and study programmes by providing—

(i) a readily available, comprehensive, up-to-date and authoritative selection of publications for the various course and teaching needs, and

(ii) publications of a more general educational nature, to broaden the students' knowledge and interests and thus encourage their individual and social development.

59 Whether because of lack of adequate library material or facilities, or failure to develop student interest, it does seem, from the frequency and generality of the complaint, that only a small proportion of technician students regularly use their college library, and of these few seem to derive as much benefit as they might.

60 Planning of the library, therefore, should aim both to provide the most appropriate reading matter and facilities for the institution's teaching programme, and to ensure that the accommodation will be arranged to permit, and to encourage, maximum utilisation by students and staff.

61 It is well known that there are many differing views—particularly between librarians and teaching staff—on the respective roles that the central library and departmental or school libraries should play within the institution. It is essential, of course, that these roles should be clarified before the planning of library accommodation is commenced.

62 There are advantages—with regard both to the standard of library service and economy—in having a large central library and small school collections comprising a limited range of types of publications, such as handbooks, practical manuals, standards, and technical journals.

63 Easy accessibility and freedom from noise are essential requirements for the location of the central library. It should, therefore, be in, or near, a main area of circulation, but sufficiently far removed from 'noisy' communal accommodation, such as a dining room and kitchen, or an amenities hall.

64 Flexibility and provision for expansion are also essential in library planning. It is common for well-established libraries in educational institutions to double their stock in less than twenty years. Libraries in new institutions expand at a much quicker rate. In addition to expansion owing to stock increase, an extension of reader accommodation can be anticipated. Other changes in library accomodation can be expected as technological developments in areas such as electronic data processing and document reproduction make their impact on library practice and services.

65 Some recently introduced library facilities and services can increase considerably the support given by the library to the teaching and study programmes of the institution. These include sound-proofed projection rooms of various sizes for class or individual use, sound-proofed carrels for programmed instructions, microfilm reading rooms and other special purpose rooms equipped with tape-recorders, record players, television closed-circuit equipment, etc. Apart from their general effectiveness, these teaching and study aids can be used to increase student motivation, and careful thought should be given to their provision in the planning of the library.

Administrative and communal accommodation

66 Since the amount and kind of administrative and communal accommodation appropriate for an educational institution depend mainly on the number of students and the range and nature of the education and training provided, the requirements for different institutions necessarily vary considerably. The degree of centralisation of the administration is a further important factor in determining the arrangement of the accommodation required.

67 In addition to the offices for administrative and teaching staff, provision should be made for a number of special purpose offices, including specially equipped rooms for student guidance and counselling services.

68 In determining the amount of administrative and communal accommodation required, it is convenient to estimate, on the basis of maximum student capacity, an amount to cover requirements for both types of accommodation and to allocate about one-quarter of that amount for administrative accommodation.

69 Of the total accommodation area, the proportion allotted for administrative and communal purposes should be higher for institutions with a small student capacity than for large institutions. 'Building Bulletin No. 5' provides a scale for determining the appropriate area for a non-residential college; one with a maximum student capacity of 1,000 requires an area of 14,700 square feet for

administrative and communal accommodation, while an area of 31,600 square feet is sufficient where the maximum student capacity is 4,000. The area per student allowed in the first example is 14·7 square feet; in the second it is only 7·9 square feet.

Circulation and ancillary accommodation

70 Although the planning of this accommodation is normally the responsibility of the architect, special features required in these areas should be indicated and discussed. Attention should be given, for example, to the desirability of having a large entrance hall, which can serve a number of social purposes. Since the spaces provided for cloakrooms, lockers and storage are often found to be inadequate, the areas proposed for these should be carefully examined. For each building, answers must be provided for the architect to questions such as:

How many occupants is it required to accommodate?
What will be the nature and density of occupancy in the different areas?
Which areas serve related functions?
What will the pattern of traffic be at peak hours?
Which areas will have the most traffic?
Which areas will require only limited access?

71 In most cases it will be found that some sections of the circulation space, such as lifts and stairways, must comply with council or other local regulations.

Additional cost items

72 It is usual to maintain a contingency fund to cover the cost of items additional to those included in the schedule of accommodation. These are mainly external works, such as general site preparation, roads and paths on the site, drainage and service mains extensions, car parks etc. The expenditure on such additional cost items is restricted to a proportion—generally up to 10 per cent—of the nett cost (that is, the cost of buildings, including fittings, built-in furniture and services ready to connect to equipment).

Zoning of accommodation

73 The principle of zoning accommodation has been applied with considerable success in the planning of many educational institutions in recent years. The accommodation is arranged so that sections serving similar functions and requiring similar conditions of 'noise' or 'quiet' are grouped together. Thus, classrooms, lecture theatres, the library and the administrative block are located in the quiet zone, and workshops and some types of recreational accommodation, such as a gymnasium and amenities hall, in the noisy zone. A neutral zone, comprising most of the communal, and some practical teaching, accommodation, is located between the other two zones.

74 Although successful zoning of accommodation is more easily achieved on a large site, the principle can be applied on a limited site, and the possibilities should always be closely examined. An attempt should be made to apply the principle of zoning when new buildings are to be erected on a partly developed site.

75 The location of departments or schools, in relation to one another, should be given careful thought to achieve maximum pooling of accommodation and to allow the easy movement of students whose courses require attendance in related departments or schools.

Liaison with the architect

76 I have stressed the need for co-operation between teaching and administrative staff and for consultation with the architect throughout the entire planning of the institution. Close liaison with the architect is required in connection with the preparation and approval of sketch plans, working drawings and functional layouts, the development of the building programme, and the preparation and approval of the programme cost estimate. This liaison must continue, of course, until the buildings have been completed and taken over.

77 The briefing of the architect and the necessary associated liaison occupy a considerable amount of time—more than can normally be given by senior teaching and administrative staff. They are likely to be carried out more efficiently and economically if a project officer is appointed to give all his time to this work.[1]

78 It is most important that the initial planning should be sufficiently thorough and accurate to eliminate the need to change the plans, except to a very minor extent, after the working drawings have been approved. Changes required after approval are likely to add considerably to costs.

79 Care should be taken also to ensure that each member of staff concerned is clearly aware of his area of responsibility in relation to equipment and furniture requirements, the preparation of schedules and the purchase of items not included in the building contract. Many problems can arise because of the wide range of equipment and furniture involved, and the possibility of duplication or omission of items to be used by two or more departments or schools. The need for advance ordering and the varying periods of delivery also make essential the strict co-ordination of these activities.

Staffing requirements

80 The well-known difficulties in recruiting suitable staff to teach technician courses are not likely to be resolved entirely by any action taken by the institutions providing these courses. The difficulties arise more from prevailing industrial and sociological conditions than from deficiencies within technical education systems or institutions. In most countries, owing mainly to the general shortage of highly skilled personnel, there are many opportunities in industry and commerce for university graduates and others with appropriate qualifications for teaching. Many of those who are qualified and wish to teach are attracted to institutions offering full tertiary education.

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[1] The project officer should be familiar with all aspects of the building programme. His duties should include attendance at all meetings held to consider the planning of the institution; liaison with the teaching staff concerned to ensure that all essential data and technical details are available when required; holding on-site consultations with the architect, engineer and other consultants, the builder and clerk of works to ensure that the functional aspects of the laboratories, workshops, etc., are satisfactory; preparing site detail modifications; ensuring correct installation and positioning of services, equipment, etc.; and preparing reports on various matters affecting the building programme.

81 There is a further serious difficulty. Not all those with the required technical qualifications are able to adapt to the teaching requirements of technician courses. H. R. Mills, in his 'Report on training facilities at the technician level in South and South-East Asia', wrote:

> 'Teachers of technical subjects are often over-qualified academically and unqualified through lack of practical experience, to handle classes of technicians; they therefore tend to create men in their own image.'[1]

82 This tendency in many graduate teachers presents a serious and widespread problem, but one which the institutions themselves can do much to resolve. Every effort should be made to give such teachers an understanding and appreciation of the needs of technician training. This can be done by appropriate in-service training and by maintaining a close liaison with those branches of industry and commerce for which the students are being trained.

83 Four further points need emphasis:

(i) Teachers should have considerable practical experience—preferably five years or more—in some section of their general teaching field. Where practicable, special leave should be given to those without such experience to enable them to spend a period in an appropriate position in industry.

(ii) Some of the teaching staff should have had considerable work experience at the technician level. Teachers with this background often are the best qualified to teach the more practical, technique subjects of technician courses.

(iii) In institutions in which a school provides instruction at trade or professional level, as well as technician level, the head of the school should be responsible for all levels of instruction. There should also be a head of each section within the school responsible for instruction at a particular level. In this way a suitably independent authority can be maintained over the entire school.

(iv) Laboratory and other ancillary staff should be given appropriate training. Particular attention should be given to the selection and training of a laboratory manager; the general effectiveness of the laboratory teaching can depend to a large extent on the interest and efficiency of the person in this position.

Textbooks, programmed instruction, audio-visual aids

84 There are obvious educational advantages in having textbooks specially written to suit local conditions. Where this cannot be done—and imported textbooks are considered unsuitable—the possibility of preparing the required books on a regional basis should be investigated. Locally produced notes, to be used in conjunction with imported textbooks, can provide a partial solution to this problem. The publication and sale of notes by the student association can have economic advantages, and can contribute to student-staff co-operation. For similar reasons, the establishment of a student association bookshop should be encouraged.

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[1] MILLS, H. R. Report on training facilities at the technician level in South and South-east Asia. Colombo, Colombo Plan Bureau, 1964. p. 37.

85 Each year a list of required books should be prepared by the librarian, in collaboration with teaching staff, and distributed to booksellers in sufficient time to enable them to provide adequate stocks. Full advantage should be taken of the availability of paperback editions, which are usually much cheaper than their hard cover equivalents.

86 In purchasing books for the library, care should be taken to ensure that, so far as possible, no group of students is placed at a disadvantage because of its numbers or subjects studied. While it is desirable that as many books as possible should be available for loan, it is necessary to aim at maximum usage, and compromises must be made—for example, between extending the range of books and providing multiple copies, between issuing on loan all copies of a textbook and retaining copies for library reference. The possibility of increasing usage by short—including overnight—loans should be considered.

87 Recent developments in the use of programmed instruction have opened up a new educational field with vast possibilities for technical education. But, apart from the expense involved and a hesitancy in some quarters to introduce a new teaching medium, several factors have prevented its more general use; the more important of these are the difficulty of obtaining suitable programmes, particularly in specialist subjects for which there is a restricted demand, and the lack of interchangeability of programmes between different types of teaching machines.

88 An institution for the education and training of technicians should be particularly well equipped, in terms of staff and facilities, to design and produce effective teaching programmes, as well as various other kinds of teaching aids. The writing and testing of programmes can be difficult and time-consuming, but with some training of staff and appropriate allocation of duties, it should be possible to produce suitable programmes, especially of the simpler linear type.

89 One possible application of teaching aids which has been little developed in most countries, and yet has considerable potential, is their use as simulators, providing educational and training experience which could not otherwise be gained as effectively by students, or gained only with some difficulty. The success achieved in the relatively few fields in which simulators are used to any extent—and particularly in motor driver training courses for adolescents—suggests that they could be developed as an effective teaching medium in the education and training of technicians. Their successful development could have economic, as well as educational, advantages, since their use should lead to a reduction in the amount of the more traditional laboratory and workshop training required, and of other practical work requirements.

90 I have referred to the need to provide suitable accommodation for the preparation of teaching aids. The development of an effective teaching aids programme calls for the co-ordination of this work, preferably by a specialist in the field. The possibility of establishing a separate audio-visual education section to co-ordinate and develop the use of teaching aids should be considered.

91 The use and development of audio-visual aids is to be the subject of a special session of this conference and I shall not discuss them further here. I would, however, emphasise the need to take advantage of the advice and assistance in this area of education offered by several organisations, such as the Association for Programmed Learning, 27 Torrington Square, London, W.C.1, the Educational Foundation for Visual Aids, the National Committee for Audio-Visual Aids in Education, both at 33 Queen Anne St., London, W.1 and the Overseas Visual Aids Centre, Tavistock House South, Tavistock Square, London W.C.1; the Programmed Instruction Centre, Enfield College of Technology, Middlesex, England; and the Research and Documentation Centre for Programmed Learning, The University of Birmingham, England.

Technician training—challenge and opportunity

92 The greatly increased awareness of the need for special courses of training for young people entering technician and other sub-professional positions in industry and commerce, and the consequential growth in this area of training, represents probably the most significant development in technical education in the past decade.[1] We can confidently expect that this development will continue, at an ever-increasing rate, for many years to come.

93 No area of technical education presents more challenge, or equal possibilities for extending the benefits of education to large numbers of our people. No other field provides such opportunity for educational experiment and innovation.

94. The planning and equipping of an institution for the education and training of technicians can, and should, be an exciting educational venture. It represents a unique test, not only of our educational competence, but of our ability to apply it in satisfying the urgent demands of a community, keenly aware of its dependence upon education and upon its educationists.[2]

95 The over-riding aim in the planning and equipping of the institution should be to provide the best possible facilities for carrying out an educational and training programme, which is not only of the highest quality, but sufficiently flexible to meet rapidly increasing and changing demands, and possessing its own distinctive character, strictly appropriate to the academic and technical levels of the personnel for whose education and training it exists.

96 It follows that the buildings of the institution, while having many features in common with other types of educational institutions, will also have their own distinctive character.

97 Because of the many fields in which technician training is provided, the diversity of training offered within those fields, and the varying requirements of local conditions, there is no one 'typical' institution for the education and training of technicians, but the buildings of each institution should clearly reflect the special nature of its educational objectives.

98 Much significant research into the accommodation requirements of technical institutions has been carried out, and has led to the publication of extremely

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[1] A table, in Appendix F of this paper, showing enrolments in final stages of technician courses conducted by the New South Wales Department of Technical Education for the years 1960–65 gives some indication of the rapid development of these courses in that State.

[2] A common problem is to provide appropriate education and training for students spread over a wide area and unable to attend the institution. One way of meeting this problem is to provide block-release courses at selected centres, which are attended by students from particular areas. This policy has been followed with considerable success in New Zealand. Another way is to introduce mobile instructional units. A statement on the use of mobile units in technical education in New South Wales is appended to this paper (Appendix G).

useful information for those concerned with the planning of an institution. But there is need for much more research into the specific accommodation and equipment requirements of technician courses.

99 I should like to suggest that research of this kind be undertaken by educational authorities in the countries represented at this Conference, and that an appropriate body be established to promote and assist such research, and to serve as a central agency for the exchange of information and recommendations. I am sure that a co-operative research programme of this kind could do much to improve the education and training of technicians throughout the Commonwealth.

100 Much has been achieved in the field of technical education by co-operation between the Commonwealth countries. In the sharing of knowledge and facilities considerable progress has been made. This Conference is a further example of the determination of the members of the Commonwealth to work together to achieve common educational objectives. I trust that it will make a positive contribution to the material and cultural welfare of the peoples of the Commonwealth.

APPENDIX A

Outline of procedures to be followed in the planning and equipping of an Institution for the education and training of technicians

1 Essential preliminary requirements in the planning of an institution.

1.1 Recognition of the need for the educational and training programme to be worked out in detail, and aims to be stated as precisely as possible, before the planning of buildings is commenced.

1.2 Recognition of the need for the stated aims to express, as exactly as possible, the actual needs and demands for the education and training of technicians for the area which the institution is required to serve.

1.3 Adoption of a method of assessing the educational and training needs for technicians appropriate to the level of economic and industrial development in the area, taking into account the extent of economic and industrial development planned for a specified future period: e.g.
 (i) methods appropriate to developing countries,
 (ii) methods appropriate to 'semi-advanced' countries,
 (iii) methods appropriate to highly industrialised countries.

1.4 Assessment of the needs for technicians in the area to be served by the institution: e.g.
 (i) needs for existing industry and planned extension of existing industry,
 (ii) needs for proposed future industry,
 (iii) overall technical manpower needs for planned economic and industrial development in the area.

1.5 Consideration of the availability of students with secondary education, or other acceptable qualifications, to enter technician courses.

1.6 Consideration of the implications for planning of the likely wastage of students from technician courses.

1.7 Determination of courses to be provided:
 (i) subject areas in which instruction is required,
 (ii) types of courses to be provided (e.g. full-time, part-time, block-release),
 (iii) estimation of initial and annual intakes into the various courses to be provided.

1.8 Determination of course structures and syllabuses in sufficient detail to estimate the allocation of hours to the various subjects and the general range of teaching accommodation required.

1.9 Determination of the type of institution in which the education and training of technicians is to be provided; e.g. polytechnic, monotechnic, institute of technology. This involves consideration of:

  (i) advantages and disadvantages of single-level and multi-level training institutions,

  (ii) implications of the type of institution for the planning and equipping of the buildings.

1.10 Determination of the number of residential places, and the form of accommodation (e.g. hostel, residential college) to be provided for:

  (i) students in full-time courses,

  (ii) students requiring short-term accommodation.

1.11 Estimation of the number of academic, administrative and other staff for whom residential accommodation is required, and determination of the type, or types, of accommodation to be provided.

1.12 Preliminary discussions with architect.

1.13 Determination of location and site, if necessary, following consideration of questions such as:

  (i) location—requirements in relation to educational aims, e.g. urban or rural, proximity to industry, availability of services, etc.; public transport facilities; proposed industrial and residential developments,

  (ii) site—estimation of area required, special requirements, need for general planning of site,

  (iii) need for forward planning.

2 Consideration of general principles, and related questions, underlying the approach to the planning: e.g.

(i) the significance of the 'education and training of technicians' for the planning, and the need to meet specific technician requirements,

(ii) the need to obtain information on similar buildings and recent educational building developments, and to take advantage of recent experience with the problems involved,

(iii) the difficulty in predicting educational and training requirements against the need for accurate prediction if the buildings are to meet particular requirements,

(iv) the need for economy, functional utility, flexibility and aesthetic appeal in educational buildings,

(v) the need to take account of maintenance and recurrent costs, as well as initial costs, of buildings and site development, and the relation of costs to the anticipated annual working budget,

(vi) the need to allow for a time-lapse (of possibly two or three years) before the buildings will be ready for occupancy,

(vii) the need to plan to suit local conditions, e.g. the type of construction, the effect on the structure if air-conditioning is necessary in a building, or throughout the buildings,

(viii) the relation of the accommodation and equipment to teaching methods and staffing arrangements, as well as to the subject matter to be taught,

(ix) the need to allow for experimentation and innovation in teaching in the institution, and ways of achieving this objective,

(x) the need to meet special requirements, e.g. open roof areas, or outdoor space for experimentation, testing of materials, etc.,

(xi) the need for close and continuing liaison between staff of the institution and the architect.

3 Detailed planning and equipping of buildings.

3.1 Determination of the extent of building to be undertaken immediately: e.g.

(i) first stage of a building,
(ii) entire major building,
(iii) whole building project.

If first stage, or first building only, need to ensure that it will be capable of functioning efficiently as an educational unit, and will fit naturally with subsequent buildings.

3.2 Classification of accommodation according to function:

(i) teaching,
(ii) administrative,
(iii) communal,
(iv) circulation and ancillary,
(v) residential.

3.3 Consideration of ways of achieving an appropriate balance between the different types of accommodation.

3.4 Preparation of the schedule of accommodation, with due consideration to:

(i) the need for co-operation between senior administrative and academic staff, and between institute staff and the architect,

(ii) the need for detailed examination of probable requirements based on estimates of the accommodation required for individual subjects,

(iii) the importance of the initial estimates of accommodation required and of the preliminary planning for the efficient functioning of the institution and its future development.

3.5 Determination of teaching accommodation:

(i) consideration of general questions affecting planning: e.g.

What range of accommodation is required?
How many students and staff are to be accommodated?
What is the expected enrolment for each course?
Is large group instruction necessary?
If so, how can this be given most effectively?
How can maximum utilisation of accommodation be achieved?
What services are required?
What local building regulations, safety requirements, etc., apply?

(ii) determination of requirements for:

- (*a*) lecture rooms (seating up to fifty students), large lecture rooms, lecture theatres,
- (*b*) laboratories—light, heavy,
- (*c*) preparation rooms,
- (*d*) workshops,
- (*e*) drawing rooms,
- (*f*) libraries—central, departmental or school,
- (*g*) tutorial and seminar rooms,
- (*h*) special purpose rooms, e.g. computer room, sound-proofed rooms for programmed instruction, remedial teaching rooms, etc.,
- (*i*) store rooms.

3.6 Determination of administrative accommodation:

(i) consideration of general questions affecting planning: e.g.

What will be the maximum student capacity of the teaching accommodation?

What will be the staff organisation?

Is centralised accommodation required?

If so, is a separate administrative block required?

Are lecturers' and teachers' rooms to be located near their work centre?

(ii) determination of requirements for:

- (*a*) senior administrators' offices,
- (*b*) heads of schools' offices,
- (*c*) lecturers' and teachers' offices,
- (*d*) general office,
- (*e*) conference and committee rooms,
- (*f*) special purpose offices, e.g. guidance and counselling offices,
- (*g*) first-aid room,
- (*h*) duplicating room,
- (*i*) store rooms.

3.7 Determination of communal accommodation:

(i) consideration of general questions affecting planning: e.g.

What activities are to be catered for?

How can maximum utilisation of areas available be achieved?

Should a large permanent assembly hall be provided, or several rooms opening into one large space?

What arrangements are required for the service of meals and sale of drinks, confectionery, etc.?

- (ii) determination of requirements for:
  - (*a*) halls and/or theatres, theatrette,
  - (*b*) staff common rooms,
  - (*c*) student common and amenities rooms,
  - (*d*) student association rooms,
  - (*e*) dining room, cafeteria, kitchen,
  - (*f*) gymnasium and/or sports hall,
  - (*g*) shops,
  - (*h*) store rooms.

3.8 Determination of circulation and ancillary accommodation (with regard to the architect's special responsibility in this area):

- (i) consideration of general questions affecting planning: e.g.
  - What area has been estimated for teaching, administrative, and communal accommodation?
  - What area is available for circulation etc.?
  - What special features are required?
  - What will be the nature and density of the occupancy in the different areas?
  - Which areas will serve related functions?
  - What will the pattern of traffic be at peak hours?
  - Which areas will have the most traffic?
  - Which areas will require only limited access?
- (ii) determination of requirements for:
  - (*a*) entrances, corridors, staircases,
  - (*b*) lifts,
  - (*c*) changerooms, washrooms, toilets,
  - (*d*) cloakrooms, lockers,
  - (*e*) cleaners' store rooms,
  - (*f*) special purpose rooms, e.g. maintenance equipment and tool rooms.

3.9 Determination of details of residential accommodation, taking into account communal accommodation to be provided, for full-time students, short-term students and visitors, and administrative, academic and other staff.

3.10 Determination of requirements as additional cost items (i.e. items not included in the schedule of accommodation), e.g. roads and footpaths, fencing, drainage works, external service mains, playing fields, car parks, etc.

3.11 Continuing consultation with architect; preparation of sketch plans; zoning of accommodation.

3.12 Preparation of programme estimate, based on average cost per square.

3.13 Check of sketch plans, areas and costs.

3.14 Preparation of working drawings and functional layouts.

3.15 Appointment of special consultants, if required.

3.16 Examination of working drawings and functional layouts, and modification, as necessary.

3.17 Approval of final drawings.

3.18 Preparation of schedules of equipment, plant and furniture.

3.19 Calling of tenders for erection of buildings and award of contract.

3.20 Supervision and inspection of construction; arrangements for:
  (i) control of building operations,
  (ii) meeting emergencies and preventing delays,
  (iii) preparation and consideration of progress reports,
  (iv) acceptance of buildings.

APPENDIX B

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APPENDIX C

Agricultural Training at the 'Middle-Level' in New South Wales

'Middle-level' training in agriculture is provided in New South Wales by the Department of Agriculture and the Department of Technical Education.

(i) *Department of Agriculture*

Three agricultural colleges are administered by this Department. These are residential colleges, and each is established on an extensive site in a rural area. Two of these—the Hawkesbury and the Wagga Agricultural Colleges—conduct two-year and three-year diploma courses, providing full-time training for students who wish to take up farming or livestock husbandry, or qualify for employment as field officer, technical officer, teacher, extension officer, manager of a butter and cheese factory, or technician in the dairying or food processing industries. The third college, which is associated with the Yanco Agricultural Research Station, conducts a one-year certificate course for those intending to work their own properties or to seek employment as managers, overseers or sharefarmers.

Hawkesbury Agricultural College is located at Richmond, approximately 40 miles from Sydney. It occupies a site having an area of 3,493 acres, 1,000 of which are under cultivation. In addition, the College uses a nearby site on the banks of the Hawkesbury River, comprising 116 acres of rich alluvial soil; about 100 acres of this site are under spray irrigation.

The College serves as a State breeding station for beef cattle, dairy cattle, horses, pigs, sheep and poultry, and students are instructed in the breeding and management of these animals.

In addition to the sections concerned with animal breeding and management, there are separate sections for dairy technology, food technology, agronomy research, horticulture and wool classing.

Well-equipped processing plants for a variety of agricultural products form part of the complex of college buildings. They include a cannery, located conveniently to the orchards, and a dairy factory which is one of the best equipped and most modern in Australia.

Teaching accommodation includes lecture theatres and classrooms, provided with a wide range of visual aid equipment, and several laboratories for practical work in chemistry, soil physics, botany, plant pathology, entomology, bacteriology and agricultural engineering.

The College workshop is equipped to provide instruction in carpentry, blacksmithing, saddlery, welding, and the care and maintenance of motors and farm machinery.

The College library, which occupies a separate, modern building, comprises several technical sections and a well-stocked general section. Technical, agricultural and livestock journals, local and overseas magazines and country newspapers are available in the reading room.

Communal and recreational accommodation includes a large hall, with stage and dressing rooms, common and meeting rooms, and a billiard room. Sports activities are catered for by the provision of football and cricket grounds, four tennis courts, a gymnasium, an olympic-type swimming pool and a rifle range.

The College has accommodation for 240 resident students. A separate room is provided for each student. A number of separate residences on the College site are available to staff.

Wagga Agricultural College is located in the centre of the southern sheep and wheat country, approximately 300 miles south-west of Sydney. The College site has an area of 3,216 acres. About 1,400 acres are used in cropping rotations, 175 acres are under flood and spray irrigation, 60 acres are used for horticulture, and most of the remainder for grazing. An area of 200 acres is used by the Agricultural Research Institute for plant breeding and research directed particularly to the needs of the area.

An important function of the College farm is the production of stud cereals of all main varieties.

Sections of the College providing instruction in the breeding and management of animals include a Dairy Section, a Piggery Section, an Arab Horse Stud, and Sheep and Poultry Sections. In many cases, the breeding herds at Wagga differ in type from those at Hawkesbury Agricultural College.

An orchard and an apiary at the College each serve the dual purpose of production and of providing student instruction.

Facilities and equipment at Wagga are generally similar to those available at the Hawkesbury College; some differences reflect the different areas of, and emphasis in, training and in the research programmes at the two Colleges.

The Wagga Technical College co-operates with the Agricultural College to provide special instruction for agricultural students in wool classing, woodwork, metalwork, welding, farm mechanics, farm surveying, building construction, farm bookkeeping and business principles.

At Wagga Agricultural College single-room accommodation is provided for 134 students, in three resident blocks.

A fully equipped dispensary and sick bay is under the control of a qualified Matron.

Yanco Agricultural College and Research Station provides training of a general nature in agronomy, animal husbandry, farm mechanics, and farm management and economics.

The College and Research Station is located on the eastern fringe of the Murrumbidgee Irrigation Area, approximately 375 miles south-west of Sydney. It occupies a site of 2,045 acres. Up to 500 acres can be used for flood irrigation, and 150 acres for spray irrigation. There are 65 acres of orchards. Almost 400 acres can be used for dry land cereal production.

Facilities include a well-equipped mechanical shop, a comprehensive range of farming plant and equipment, and a library.

Single-room accommodation is provided for 100 students.

The Agricultural Extension Services of the Department of Agriculture utilise more than twenty research institutions and experimental stations or farms, located strategically throughout the State.

The Extension Services provide middle-level instruction of a more informal type by means of short-term schools, field days and visits to farms. They also provide in-service training courses for Departmental staff.

Instruction is given by members of the Department's professional staff, which comprises some 600 officers.

(ii) *Department of Technical Education*

For many years the Department of Technical Education provided rural courses through two teaching schools—the School of Agriculture and Horticulture and the School of Sheep and Wool.

In 1964 these two schools were combined to form a single School of Rural Studies in order to achieve a greater degree of co-ordination between the different branches of rural training.

The School of Rural Studies comprises three Divisions—Agriculture, Horticulture, and Sheep and Wool. Certificate, post-certificate and special courses are conducted by each Division. Full-time and part-time courses are offered. Many of the special courses are available also by correspondence.

Agriculture. In addition to the certificate and post-certificate courses in agriculture, instruction is given in a wide range of subjects, which include dairy technology, dairy bacteriology, poultry farming, pig raising, sheep and cattle grazing, agronomy, irrigation, fruit growing, vegetable growing, soil science, farm records, farm mechanisation, tractor maintenance, operation and care of farm machinery, and wood technology and forestry.

The agriculture certificate and post-certificate courses are conducted at Sydney Technical College, and other agricultural courses are provided at any country centre where there is sufficient demand.

The theoretical and practical instruction given in several agricultural courses is supplemented by excursions and extended visits to various farms and stations throughout the main farming areas of the State.

Horticulture. The Horticulture Division occupies a 23-acre site at Ryde, a suburb of Sydney. More than two-thirds of the site has been divided into practical field sections, which include various types of gardens, an orchard, turf research plots, and a nursery, with bush house and two glasshouses.

In addition to the certificate and post-certificate courses in horticulture, special courses are offered in subjects such as floristry, greenkeeping and the culture of Australian wild flowers.

Mechanical equipment available for maintaining and cultivating the site includes light garden tractors, motor mowers and spraying machines.

The division is well equipped for the teaching of science subjects. Laboratories on the site are provided with an extensive range of chemical and biological apparatus and equipment.

Facilities for practical work on the Ryde site are available also to students taking agriculture courses.

Sheep and Wool. The headquarters of the Sheep and Wool Division occupy a four-storey building in the midst of some of Sydney's largest wool stores. The ground floor contains a library, museum, demonstration room and a model wool shed in which shearing techniques are demonstrated. On the first floor there is a modern testing house, a laboratory and a projection room. The other floors are equipped with modern facilities for practical instruction in wool classing.

Courses conducted by the Sheep and Wool Division include, in addition to the certificate and post-certificate courses, special courses in shearing shed experting, shearing accounting and wool sorting and repacking. A six weeks full-time course in shearing was introduced in 1966.

Instruction in one or more sheep and wool courses is given at some sixty centres throughout the State's wool districts.

The Sheep and Wool Division also conducts courses for senior students in a number of secondary schools. The subjects taught are sheep husbandry, wool science and wool classing.

APPENDIX D

Schedule of Accommodation for a Science Block, Granville Technical College, New South Wales

Schedule of Accommodation

Applied Science—Ground Floor, Block 7

Room No.	*Type of room*	*Area (square feet)*	*Dimensions (feet)*
29	General chemistry laboratory	1,440	30 × 48
30	General chemistry laboratory	1,440	30 × 48
31	Balance room—doors to 29 and 30	200	10 × 20
32	Preparation room—door to 33 servery, windows to 29 and 30	200	
33	Issue room—doors to 29 and 30	200	
34	Main chemistry store—double doors to corridor—hoist to upper floor laboratories	500	
35	Lecture-demonstration room adjacent to 29, door to corridor—water, gas and power to demonstration bench	720	
36	Lecture-demonstration room adjacent to 30, door to corridor—water, gas and power to demonstration bench	720	
37	Office—head teacher	130	
38	Office—2 teachers	150	
39	Office—2 teachers	150	
40	Laboratory staff room	150	
41	Teachers' common room	250	
		6,250	

Doors to rooms 37 to 41 open to corridor—sink and drainers required in 40 and 41. Room 34 must be on ground floor. Rooms 29 to 41 to form one group.

Applied Science—First Floor, Block 7

Room No.	*Type of room*	*Area (square feet)*	*Dimensions (feet)*
42	Organic chemistry laboratory	1,200	30 × 40
43	Ether room—door to 42	160	16 × 10
44	Preparation room—door to 45	160	16 × 10
45	Store and issue room—door to 42	160	16 × 10

Room No.	*Type of room*	*Area (square feet)*	*Dimensions (feet)*
46	Analytical chemistry laboratory	1,200	30 × 40
47	Balance room—doors to 42 and 46	200	20 × 10
48	Instrument room—doors to 42 and 46	400	20 × 20
49	Preparation room—door to 50	240	15 × 16
50	Store and issue room—door to 46	240	15 × 16
51 and 52	Lecture-demonstration rooms. Adjacent to 42 and 46 respectively—doors to corridor—water, gas and power to demonstration bench	1,440	24 × 30 each
53	Office—head teacher	130	
54	Office—2 teachers	150	
55	Office—2 teachers	150	
56	Teachers' common room	250	
		6,080	

Doors 53 to 56 open to corridor—sink and drainer in 56. Rooms 42 to 56 to form one group, and must be on one floor.

Applied Science—Second Floor, Block 7

Room No.	*Type of room*	*Area (square feet)*	*Dimensions (feet)*
57	Biology laboratory	1,440	30 × 48
58	Servicing room—door to 57	160	10 × 16
59	Preparation room—door to 60	160	10 × 16
60	Store and issue room—door to 57	160	10 × 16
61	Balance room—doors to 57 and 64	200	10 × 20
62	Preparation room—door to 63	200	10 × 20
63	Store and issue room—door to 64	200	10 × 20
64	Geology and Engineering Chemistry laboratory	1,440	30 × 48
65 and 66	Lecture-demonstration rooms. Adjacent to 57 and 64 respectively—doors to corridor—water, gas and power to demonstration bench	1,440	24 × 30 each
67	Office—2 teachers	150	
68	Office—2 teachers	150	
69	Laboratory staff room	150	
70	Instrument store	168	
		6,018	

Doors 67 to 70 open to corridor. Sink and drainer in 69. Rooms 57 to 70 to form one group, and must be on one floor.

General	*Area (square feet)*
Cleaners' stores—5 required with shelves and sink (40 each)	200
Cleaners' rooms—1 male, 1 female with clothes lockers and sink and drainer (150 each)	300
Toilets—approximately 4 male and 4 female, designed for 60 persons each, plus 8 staff singles—4 male and 4 female	Included under stairs, corridors, etc.

TOTAL AREA, BLOCK 7 21,600 square feet

The three Applied Science sections are one above the other for convenience of services. Provide hoist for chemicals, etc.

	Area per student (square feet)
Management Studies and Commerce	
Work study	60
Geography and commodities	35
Typewriting and accounting	30
Studios	
General drawing and painting	50
Life and design	40
Drawing Offices	
Advanced (mainly advanced engineering, advanced building and all architecture courses)	50
Intermediate (using imperial boards)	30
Elementary (using half-imperial boards)	25
Classrooms	
Demonstration (with demonstration bench)	22
General	20
Demonstration and small lecture rooms (Close seating)	
(*a*) For first 30 students (or part)	15
(*b*) For next 20 students (or part)	12

Libraries

An area based on an allowance of approximately 30 square feet for each reader is commonly recommended for basic library accommodation, comprising reading rooms and stack rooms. Additional space is required for offices, workrooms and other special purpose accommodation.

The Building Bulletin quotes the Ministry of Education Circular 322, which recommends an area of 32 square feet per reader, the number of readers being determined for colleges of further education by the following formula:

(1) 7 per cent of maximum student capacity where that capacity is not over 1,000;

(2) Where the maximum capacity exceeds 1,000, 7 per cent of the first thousand, 4 per cent of the next two thousand, and 3 per cent of the rest.

Examples of the application of this formula given in the Building Bulletin are as follows:

Maximum student capacity	*Library area (square feet) (Reading and stack rooms)*
1,000	2,240
2,000	3,520
3,000	4,800
4,000	5,760

ADMINISTRATIVE AND COMMUNAL ACCOMMODATION

As stated in the main paper, it is common practice to estimate, on the basis of maximum student capacity, an area to cover requirements for both administrative and communal accommodation, and to allocate approximately one-quarter of the area for the administrative accommodation.

The following table is given in Building Bulletin No. 5 as a guide to the overall area to be provided for administrative and communal accommodation.[1] It will be noted that the area per student decreases as the maximum student capacity is increased.

Maximum student capacity	*Area per student—square feet*	*Total area—square feet*
500	21·0	10,500
750	16·8	12,600
1,000	14·7	14,700
1,250	13·1	16,375
1,500	12·0	18,000
1,750	11·1	19,425
2,000	10·5	21,000
2,250	9·9	22,275
2,500	9·5	23,750
2,750	9·1	25,025
3,000	8·8	26,400
3,250	8·5	27,625
3,500	8·3	29,050
3,750	8·1	30,375
4,000	7·9	31,600
4,250	7·7	32,725
4,500	7·6	34,200

APPENDIX F

New South Wales Department of Technical Education

Final Stage Enrolments in Technician Courses 1960–1965

Course	1960	1961	1962	1963	1964	1965
CERTIFICATE						
Building						
Architectural Drafting	—	2	—	5	38	44
Building	—	—	—	—	24	39
Commerce						
Accountancy	486	565	708	729	745	842
Transport Administration	7	10	7	8	15	15
Stock Exchange and Securities	—	—	—	—	—	15
Engineering						
Electrical Engineering	75	93	122	123	171	192
Electronics and Communications	41	43	73	83	91	86
Industrial Instruments	—	2	11	8	6	4
Land and Engineering Survey Drafting	45	62	53	126	174	182
Marine Engineering Technology	36	24	20	25	35	33
Mechanical Engineering	168	223	306	424	479	562
Mining—Coal	6	3	9	16	24	4
Coal Mine Surveyors	—	10	1	1	—	13
Metalliferous Mine Surveyors	2	—	1	6	7	4
Production Engineering	15	37	43	74	68	100
Structural Engineering	—	5	21	45	53	72
Surveying	65	66	88	76	51	22
Engineering Surveying	—	—	—	—	—	11
Rural Studies						
Agriculture	19	21	2	26	22	15
Horticulture	29	55	38	35	71	73
Wool Classing	127	103	109	107	91	128
Science						
Biology	49	40	67	81	121	114
Chemistry	60	76	111	149	182	191
Electroplating	4	6	12	9	7	10
Health Inspection	27	31	63	51	54	64
Metallurgy	26	50	55	54	78	86
Others						
Advertising	—	—	—	36	25	33
Ceramics	—	—	—	—	3	11
Commercial Art	—	—	—	—	23	24
Management	102	96	100	131	134	152
Personnel Administration	5	11	24	30	44	59
Supervision	499	638	911	951	773	799
Textile Dyeing	5	—	6	2	—	7
Women's Handicrafts	33	26	16	26	17	32
TOTAL CERTIFICATE	1,931	2,298	2,977	3,437	3,626	4,038

Final Stage Enrolments in Technician Courses 1960–1965

Course/Field of Instruction	1960	1961	1962	1963	1964	1965
POST-CERTIFICATE						
Agriculture and Horticulture	15	12	17	29	27	14
Commerce	190	370	387	379	402	458
Medical Technology	—	—	—	—	23	65
[1] Health Inspection	42	27	115	95	68	80
Metallurgy	—	—	—	23	31	11
[1] Very High Frequency Techniques	—	—	8	—	—	—
[1] Electrical Engineering	—	3	26	34	29	43
[1] Industrial Electronics Equipment	—	—	—	11	11	—
Engineering Principles of Computers	—	—	—	—	16	—
[1] Mathematics IV	—	—	—	—	—	21
Mechanical Engineering	—	—	39[1]	112[1]	28	48
[1] Coal Mining	12	4	4	—	3	2
[1] Wool Valuing	—	16	35	16	13	15
TOTAL POST-CERTIFICATE	259	432	631	699	651	757
POST-TRADE						
Building Foreman and Clerk of Works	180	239	245	260	280	275
Other Building	149	125	184	215	182	190
Industrial Electronics	85	58	69	72	79	71
[1] T.V. Receiver Servicing	100	148	182	134	112	106
Other Electrical	15	86	90	188	165	152
[1] Automatic Transmission	56	95	103	144	160	228
[1] Automotive Engineering Electrical	96	138	157	143	173	148
Other Automotive	131	113	171	302	163	97
Bread Manufacture Supervisory	—	—	—	—	13	6
Cake Ornamenting Advanced and Other Food	13	27	—	20	12	24
[2] Graphic Arts Production and Supervisory	11	4	17	34	38	62
Other Printing	99	137	147	147	143	152
Hairdressing	96	72	101	85	58	101
Plumbing	117	31	63	43	56	414[3]
Mechanical Engineering	240	185	308	295	313	285
Textiles	—	—	—	11	9	1
Vehicle Trades	—	—	—	—	112	317
TOTAL POST-TRADE	1,388	1,458	1,837	2,093	2,068	2,629

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[1] Course is of one year's duration.

[2] After 1960 classified as 'Special'.

[3] Plumbing figures include St. I Advanced Plumbing in 1965.

Final Stage Enrolments in Technician Courses 1960–1965

Course/Field of Instruction	1960	1961	1962	1963	1964	1965
SPECIAL						
Diagnostic and Therapeutic Radiography	—	—	—	—	30	29
Dress Design	—	5	9	16	9	11
General Design	—	7	4	2	2	9
Industrial Design	2	2	9	2	6	8
Interior Design	3	10	4	15	27	21
Textile Design	—	—	—	3	5	5
Civil Engineering Foremen's and Overseers'	16	14	24	26	16	21
Footwear	3	3	7	3	9	8
[1] Data Processing and Computers	—	—	73	80	210	278
Day Commercial Classes	2,293	2,479	2,908	3,147	3,591	3,011
Sheep and Wool	673	636	692	741	791	826
Television Technicians A.B.C.	—	—	12	9	10	5
[1] T.V. Station Operators	24	25	22	28	19	29
T.V. Studio Techniques	36	46	50	56	48	42
[1] Illumination	36	51	41	77	12	14
Marine Engineering (Endorsement)	—	8	8	1	2	10
Purchasing and Supply Management	42	26	94	26	64	56
Retail Distribution	—	—	—	—	—	8
TOTAL SPECIAL	3,128	3,312	3,957	4,232	4,851	4,391

[1] Course is of one year's duration.

APPENDIX G

Mobile Instruction Units, New South Wales

New South Wales has a population of approximately 4,200,000, in an area of 309,433 square miles. Some 133,000 of these people are enrolled with the Department of Technical Education, studying one or more of 450 courses at nearly 200 colleges and associated centres throughout the State. A further 17,000 are enrolled in correspondence courses. But a small group of students—283 in 1965—receive their technical training in miniature, mobile colleges in the form of specially equipped railway carriages. Other students, as yet limited in number, are receiving instruction in a well-equipped 20 ft caravan which was introduced in 1964 to provide training in shearing shed experting in country towns where there are no permanent facilities for such training.

The problem of providing technical education for a population spread thinly over a vast area of New South Wales has been met by the Department of Technical Education in three ways:

(i) by establishing a network of technical colleges throughout the State,

(ii) by providing correspondence instruction, and

(iii) by the use of mobile instructional units.

The mobile units have become an important ancillary service of technical education.

At present there are four rail mobile instructional units, each consisting of three railway carriages, one being used as a workshop, one as a lecture and demonstration room, and one as accommodation for the officer-in-charge. They provide training for apprentices in several trades, and also instruction for other country students in such subjects as motor maintenance, farm mechanics and workshop practice.

The first unit entered service in 1938. Units 2 and 3 started in 1939, and in 1948 unit 4 was introduced.

Originally, all four units concentrated on subjects in the fields of mechanical and automotive engineering, and the equipment in the units included lathes, shaping, drilling and grinding machines, farm machinery, the latest types of automatic testing equipment, electric and oxy-acetylene welding apparatus, fitting and sheet metal work benches, blacksmithing anvil and forge, alternator, 16 mm sound film projector, strip film projector, kerosene engine and tools. As in technical colleges, replacements and additions have been made as new equipment and new processes have been introduced.

In 1961, Unit 3 was completely refitted to give instruction in electrical trades. One of the three cars is now equipped as an electrical machines laboratory, fitted with a.c. and d.c. machines, test benches and portable electric apparatus.

Final Stage Enrolments in Technician Courses 1960–1965

Course/Field of Instruction	1960	1961	1962	1963	1964	1965
SPECIAL						
Diagnostic and Therapeutic Radiography	—	—	—	—	30	29
Dress Design	—	5	9	16	9	11
General Design	—	7	4	2	2	9
Industrial Design	2	2	9	2	6	8
Interior Design	3	10	4	15	27	21
Textile Design	—	—	—	3	5	5
Civil Engineering Foremen's and Overseers'	16	14	24	26	16	21
Footwear	3	3	7	3	9	8
[1] Data Processing and Computers	—	—	73	80	210	278
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T.V. Studio Techniques	36	46	50	56	48	42
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Retail Distribution	—	—	—	—	—	8
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[1] Course is of one year's duration.

APPENDIX G

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The first unit entered service in 1938. Units 2 and 3 started in 1939, and in 1948 unit 4 was introduced.

Originally, all four units concentrated on subjects in the fields of mechanical and automotive engineering, and the equipment in the units included lathes, shaping, drilling and grinding machines, farm machinery, the latest types of automatic testing equipment, electric and oxy-acetylene welding apparatus, fitting and sheet metal work benches, blacksmithing anvil and forge, alternator, 16 mm sound film projector, strip film projector, kerosene engine and tools. As in technical colleges, replacements and additions have been made as new equipment and new processes have been introduced.

In 1961, Unit 3 was completely refitted to give instruction in electrical trades. One of the three cars is now equipped as an electrical machines lahoratory, fitted with a.c. and d.c. machines, test benches and portahle electric apparatus.

Included is a wide range of resistors, inductors, capacitors, basic electronic equipment, and electrical measuring instruments. The remainder of the carriage is used as a lecture and drawing room. In the second coach, most of the students' practical work is carried out, and facilities have been provided for bench fitting and lathe work, electrical wiring practice and armature and stator wiring. The third car continues to provide living accommodation for the officer-in-charge.

The ready co-operation of the Department of Railways has enabled the Department of Technical Education to move the units along selected sections of the State's railway network and to choose towns where the demand for training is greatest.

The units operate on circuits which usually include three centres, and stay for one or two weeks in each town visited. They have not completely eliminated the problem of distance for students, as there are still many cases of pupils coming 40 miles to classes. It could reasonably be claimed, however, that the units have considerably eased the hardship of travel for many students.

During each unit's week or fortnight stay in a town the officer-in-charge is able to give concentrated practical instruction and lectures to students and to leave them assignments for completion during the unit's absence. A programme of daylight training of apprentices is followed, the students taking the same courses as those provided in the technical colleges. In addition, qualified tradesmen are able to take advantage of the opportunity to enrol in refresher courses and to bring themselves up to date on new methods and new equipment introduced into their trade. Equally important, the units have provided practical instruction for farmers in the use of farm machinery and the care and general maintenance of their equipment.

The latest development in the use of mobile units was initiated in January 1964, when the Sunbeam Corporation officially handed to the Department of Technical Education a mobile road unit designed for the teaching of shearing shed experting.

The design and construction of the unit presented many problems. Much complicated shearing equipment is in use today and its installation for teaching purposes in technical college buildings takes up a considerable amount of space. Fitting a selection of such machinery into a unit designed to move from place to place was not easy. The problems were solved, however, with the designing and building of a 20 ft steel and aluminium trailer which can travel easily along New South Wales country roads and which, when stationary, provides quite substantial teaching accommodation. There are five shearing stands in the unit, two of which are electric and three belt driven, the latter being powered by a 3 h.p. petrol motor. An electric double-ended grinder has also been fitted to one wall and benches are constructed at each end of the trailer. There is ample accommodation and equipment for an instructor and a class of eight to ten students.

In its eighteen months of operation the road mobile unit has proved its value. Although sheep and wool courses are among the most widely available of all the Department's courses, many small teaching centres do not possess the costly equipment necessary for instruction in shearing shed experting. The new unit has enabled training to be extended to those centres where student numbers are large enough to warrant forming a class.

The mobile instructional units have more to their credit than providing a basic training medium. In New South Wales it has been found that the operation of a unit has generally stimulated interest in technical education throughout the district serviced. Quite often this awareness of the value of technical education has led to a demand for more training facilities. In the towns of Griffith, Leeton and Narrandera, for example, all of which were visited by Unit I in its early days, three technical colleges have been established, each one administering a number of smaller centres. In other parts of New South Wales, colleges at Grafton, Gunnedah, Kempsey, Cootamundra, Murwillumbah, Taree, Casino, Temora, Narrabri, Cowra and Muswellbrook have had their origins in the units, or have been expanded due to the units' activities. In some cases the unit and the college work side by side until enrolments are sufficient for the college to provide the training on a permanent basis. At this point the unit is transferred to begin its pioneering work on another circuit.

Report of Working Group A(3)—Planning and Equipping Institutions

Chairman: Mr. A. W. Chisholm (Britain)

Introduction

1 Many factors influence planning, particularly the country or locality and the kinds of technician courses to be established. Planning must be decided on as broad a range as possible in order that the facilities provide flexibility for the varying needs of technicians. Flexibility in planning and equipping institutions must be the keynote of any project. Growth, both quantitative and qualitative, must be allowed for. Full assessment must be made of all factors that are likely to influence development of technician courses in any one place. The Group commend the principles in the lead paper presented by Mr. Dunbar as a sound basis of approach to the subject. It is suggested, however, that an estimate of the amount and usage of teaching accommodation should precede the preparation of an Accommodation Schedule. Further, the drawing of a schedule of room, laboratory and workshop usage should be given priority in the early stages of planning. An example of a schedule of room usage is included in the Appendix to this report. The optimum student number might be fifteen or sixteen for a practical class in technician courses and thirty or thirty-two for theory subjects. It is recognised that present-day factors, e.g. shortage of teachers, may mean planning for larger units and, on the other hand, safety requirements may demand smaller units for practical work.

Forward planning

2 Forward planning for years ahead, must be a major aim. It is suggested that ten years would not be inappropriate even though the evidence required at the initial planning stage was not fully available. Large sites should be the aim in order to provide for the future. Each building on the site should be planned only after a thorough assessment has been made of its functions. The teaching methods to be adopted should be determined in order that the classrooms, laboratories, and workshops are designed to provide whatever modern methods of communication are needed. Although an institution today may not have any immediate intention of installing television it should decide whether ducts are to be provided in order that the necessary wiring can be easily installed at a later stage. Research is needed into the whole field of the design of classrooms, laboratories and workshops, and in the field of audio-visual methods of communication. The design of teaching rooms can be such that they determine teaching methods, e.g. laboratories can be built for student practical work only and not include traditional teacher demonstration benches, chalkboards or stools. Every lecture theatre should be fully equipped for the use of audio-visual aids.

3 The British Ministry of Education Building Bulletin No. 5[1] examines the problems of planning and building. Although much sound guidance is given, based on experience in the United Kingdom, it may be necessary to modify the

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[1] GREAT BRITAIN. Ministry of Education. New Colleges of Further Education; 3rd ed., London, H.M.S.O., 1959. (Building Bulletin No. 5.)

specified areas to suit local conditions. The Bulletin might have a more flexible approach, particularly with regard to areas for communal accommodation and width of driveways. The Group suggest that a revised Bulletin No. 5 take account of the needs of other countries and climates.

Planning personnel

4 The following are key personnel in the planning and equipping of any institution: (1) the Architect; (2) the Principal; (3) Heads of Departments. The appointment of these people should be made early if major difficulties are to be avoided at the various stages of development. The architect should fully familiarise himself with social, legal and climatic conditions prevailing in the area. The institution should be constructed to achieve, as far as possible, major flexibility and aesthetic appeal having regard to the need for economy. Close co-operation must be maintained between architect and education staff at all stages in the planning and construction of the institution.

Communal and recreational facilities

5 The creation of central communal and recreational facilities for students and staff is supported. Many institutes today are growing into large and complex organisations and great care is needed to ensure that the educational and social benefits to be derived from these facilities are not sacrificed through the expansion and growth of other parts of the institution. A large mixed common room is desirable, but in addition to this, provision should be made for a separate common room for the use of women only. In association with the main common room there is need for other rooms for television, games, student union activities, discussion groups, etc. In the case of halls of residence the more mature the student the greater the need for single study bedrooms. The study bedrooms should be grouped as family units with appropriate common and utility rooms. College shops should be provided for the supply of books and stationery, and might include a pharmacy and hairdresser. In the dining room it is doubtful if any institution can provide space for all students to be seated at any one time. The majority of institutions will therefore have to give careful consideration to the number of sittings that are to be provided. Economy of time and staff may lead to cafeteria systems for the serving of meals. An effective way of influencing the student behaviour and way of life might be more formal meals with members of the teaching staff. A combination of the above should be the aim. Where provision is to be made for special foods to be served, extra provision for cold storage and refrigeration should be considered.

6 Student Union facilities can greatly contribute to the social development of students. In certain circumstances division must be made between part-time and full-time students, but normally they should not be segregated.

Staff accommodation

7 Teaching staff accommodation should be provided after an analysis has been made of the functions and duties of staff of each type. In addition to a common room, each teacher or group of teachers needs rooms for storage, progress records, teaching materials and study. Further facilities for staff are required in classrooms, laboratories and workshops for storage. These facilities can be so

designed to provide the security and privacy required within the teaching area. The Group does not support the creation of a multiplicity of offices for teaching staff leading to unnecessary duplication of administration to the detriment of the academic work. The structure of the staff should be known before planning is commenced.

8 The smooth working and servicing of an institute can be considerably improved by having adequate accommodation for non-teaching staff. This should include cloak rooms, staff rooms, wash and change rooms. Careful analysis needs to be made of the location, functions, duties, etc., of all non-teaching staff, for example, laboratory technicians, workshop servicing personnel, cleaners, porters, caterers, caretakers, storemen, gardeners, clerical staff and junior library staff.

Assembly Hall

9 An assembly hall was considered necessary for most institutions and should be sufficiently large to accommodate more than the anticipated student numbers. The hall should be designed for normal college activities and for use by external bodies. The use of the assembly hall in this way may encourage closer liaison with local institutions and industry and may encourage such organisations to provide additional facilities.

Library facilities

10 Stress was placed on the fact that the library is as important as workshops and laboratories. Adequate funds should be assured for the provision of book stocks and qualified staff. Annual allocation of funds should be made for developing the library. The Working Group favours a central library service to the college and does not support the growth of a reference shelf in a department into a library. It was agreed, however, that certain reference material is essential in laboratories and workshops for teaching purposes.

11 There is a universal shortage of suitable books for technical education. Thus books on Building are not always appropriate to local social, legal and climatic conditions. More relevant books must be written and to do this authors must be found. The Group strongly recommends that scholarships for the writing of textbooks for certain countries should be made available. Low-priced book schemes, as a form of aid to underdeveloped countries, should be encouraged. It is difficult in tropical areas for retailers to carry large stocks of books and it is recommended that the college or institute should provide for the establishment of a bookshop on the campus. It is essential for teachers to plan ahead so that too rapid a changeover of textbooks does not take place.

12 The planning of the library as an aid to both student and teacher cannot be over-emphasised. The Group commends the following references:

(1) ASSOCIATION OF TECHNICAL INSTITUTIONS and ASSOCIATION OF PRINCIPALS OF TECHNICAL INSTITUTIONS. Technical College Buildings, second interim report; the College Library. London, A.T.I., 1963.

(2) LIBRARY ASSOCIATION. Colleges of Technology and Further Education sub-section. College Libraries: recommended standards of library provision. London, Library Association, 1965.

13 The provision of sets of books or notes for class use may be required of a library. Tropical conditions can seriously affect library stocks and air conditioning may be needed—see the work done by the Libraries Adviser, Inter-Universities Council for Higher Education Overseas, Bedford Place, W.C.1.

Laboratories and Workshops

14 The planning and equipping of laboratories and workshops is directly influenced by the teaching methods. Present-day trends show a movement from teacher-centred to student-centred teaching. This will lead to a diminishing use of the lecture theatre and an increased use of laboratories and workshops. The students in this way will progress in smaller groups on assignments and projects. Laboratory and workshop layouts should reflect this approach to teaching.

15 Experience in Britain has shown that with the development of very large institutions, with the majority of courses being part-time, the provision of cloak-rooms for the students might well be considered within each classroom. This method provides better security for the personal clothing of each student and also cuts down considerably the movements of students through the building.

16 In workshops and laboratories a change-room adjacent to the workshop is often desirable. Such a room should take full account of the special provisions that may be required.

Storage facilities

17 Storage facilities required in laboratories, workshops and classrooms should be decided after an analysis of the kind of work to be done and not laid down in rigid terms as a percentage of the laboratory, workshop or classroom area.

Summary

(1) The function of the institution and the composition and content of technician courses must be defined before buildings and equipment can be decided upon.

(2) Forward planning and flexibility in design are essential in the provision of buildings and equipment for the education and training of technicians.

(3) The teaching methods to be employed will exert a major influence on the design of classrooms, laboratories and workshops. Consideration therefore must be given to these methods in the early stages of the planning of an institution.

(4) The British Ministry of Education Bulletin No. 5 (see paragraph 3) might be used with advantage as a general guide in planning buildings. It is considered, however, that, in some respects, it is not sufficiently liberal.

(5) The architect is a key man in the planning of a building. At every stage of the work he must co-operate closely with the education staff who are to use the building.

(6) Central communal and recreational facilities play a major part in influencing the social development of young technicians as growing members of society. Adequate facilities of this type should be provided and the utmost care exercised in their design and use.

(7) The design of teaching and non-teaching staff facilities should be based on an analysis of the functions and duties of each type of staff.

(8) An adequate library is essential in educating and training technicians. It must be designed and equipped to give a comprehensive service to both students and staff.

(9) Research is needed into the design of buildings and related matters such as the layout of workshops and laboratories.

Conclusions

The keynote of this report is the need for flexibility if one is to cater for the ever-changing needs of a multiplicity of technician courses. Forward planning contributes to the full development of a co-ordinated institution. Attention to detail in the early planning stages avoids costly alterations in the future. When considering a plan for an institution, there are innumerable questions to be resolved. For instance: Is there to be a Board Room? First Aid Room? Women Students' Rest Room? Administration Unit? Reception Areas? What is the function of each? How many people will use it? Is it in the right location? If the institution doubles in size, is it still in the right location? If not, what provision should be made for the change in accommodation? If What, Where, When and Why are not repeatedly asked, and answers found, the institution being planned will not meet the changing needs of the ever-increasing number of technicians who are being trained and educated.

APPENDIX

Method of Calculating Number of Classrooms, Laboratories, Workshops, in a New College

Schedule of Courses

O.N.D. Course in Engineering. F.T. 120 students in 4 classes of 30 each—split into groups of 15 for workshop and laboratory instruction.

M.E. Technician Course. P.T. Day. 270 students in 9 classes of 30 each—split into groups of 15 for workshop and laboratory instruction.

H.N.C. Course in Production Engineering. P.T. Day. 120 students in 4 classes of 30 each—split into groups of 15 for workshop and laboratory instruction.

Electrical Technicians Course. P.T. Day. 210 students in 7 classes of 30 each—split into groups of 15 for workshop and laboratory instruction.

Time Tables

(Courses last 7 hours/day)

		hours/day
O.N.D.	Classroom	2
	Drawing Office	1½
	Eng. Lab.	1¼
	Elect. Lab.	1¼
	Workshop	1
M.E.T.	Classroom	2½
	Eng. Lab.	1½
	Drawing Office	1¼
	Workshop	1¾
H.N.C.	Classroom	4½
	Drawing Office	1
	Laboratory	1½
E.T.	Classroom	2½
	Drawing Office	1½
	Laboratory	2
	Workshop	1½

Course	Stage	No. of Students	No. of Sects. per week	No. of Sects. per day	Total Hours required per Section per Day				
					Cl. rm. (30)	Dwg. Off.	Mech./ Prod. Labs.	Elect. Labs.	Work-shops
O.N.D.	1	60	2	2	4	3	5	5	4
O.N.D.	2	60	2	2	4	3	5	5	4
M.E.T.	1–4	270	9	2	5	2·5	6	—	7
H.N.C.	1–4	120	4	1	4·5	1·5	3	—	—
E.T.	1–4	210	7	2	5	3	—	8	6
Prep.	1–2	90	3	1	3·5	3	4	—	—
					26	16	23	18	21

Number of Classrooms (capacity 30) required . . $\frac{26}{7\times0\cdot8}=4\cdot5$
(Room loading 80 per cent)

Number of Drawing Offices (capacity 30) required . $\frac{16}{7\times0\cdot8}=2\cdot8$
(Room loading 80 per cent)

Number of Mech./Prod. Labs. (capacity 15) required $\frac{23}{7\times0\cdot8}=4\cdot1$
(Room loading 80 per cent)

Number of Electrical Labs. (capacity 15) required . $\frac{18}{7\times0\cdot8}=3\cdot2$
(Room loading 80 per cent)

Number of Workshops (capacity 15) required . . $\frac{21}{7\times0{\cdot}7} = 4{\cdot}3$
(Room loading 70 per cent)

Note: The above calculations serve only as an approximate guide. The following points would then arise for consideration:

(1) The number of classrooms could be 5 with capacity 30, or 4 with capacity 30 and 2 with capacity 15.

(2) The number of drawing offices could be 3, or 2 plus one combined drawing office/classroom.

(3) With regard to laboratories, the nature of the work to be done in the college would have to be taken into account and a decision made as to the types of laboratory required.

(4) The same considerations would have to be applied to workshops. Probably the best procedure would be to have a workshop area accommodating 75 students.

Discussion of Report in Plenary Session

It was recognised that it is rarely possible to plan the establishment of an institution with full knowledge of the exact purposes to which it will be put when it opens some years later. However, it is essential for as much forward planning to be done as circumstances permit and for the plans to be flexible.

The importance of full consultation with interested parties was stressed. All concerned with the establishment of an institution including those concerned with the provision and control of finance should be consulted and invited to collaborate in the planning process. Senior members of staff of the proposed institution, in addition to the Principal, should be appointed so as to be available for consultation at the planning stage: it is a false economy to delay their appointment until the work of teaching and administration becomes necessary.

In discussing the proportion of teaching to non-teaching space, delegates agreed that no set formula could be adhered to. Recommended norms have been established in some countries, but these need revision from time to time and further research carried out. Economies may be effected, especially in the early life of an institution, by dual purpose accommodation, e.g. assembly-hall/cafeterias. However, it is a mistake not to plan for the maximum capacity in some areas, e.g. whilst individual classrooms can be added to a series, a main hall cannot be so easily enlarged. It was again emphasised that flexibility in planning must be the keynote.

It was agreed that central libraries are preferable to departmental libraries, although the need for particular reference works to be available in departments was recognised. Policy in regard to the purchase of books should be in the hands of departmental heads, but control of the book stock should rest with the librarian.

The provision of text-books suitable for local conditions is considered a major problem. It was pointed out that some local solutions have been found in which the academic staff and libraries of institutions have played a part.

CHAPTER VII

The Supply and Preparation of Teachers and Ancillary Staff

Lead paper presented by Mr. A. MacLennan, Director, Huddersfield College of Education (Technical), Huddersfield, England.

(*Based on practice at Huddersfield College of Education (Technical)*)

Introduction

1 Industry, having identified the tasks to be undertaken by its technicians, organises and conducts their practical training and experience. The associated vocational education is planned in consultation with specialists from the relevant sectors of technical education. The technical teacher trainers become involved when these exercises are complete. Their contribution begins with the recruitment of persons having the specialist technical qualifications and variety of responsible industrial experience to integrate the vocational training and educational elements in technician courses. Appendix A of this paper gives a list of acceptable qualifications applicable in England. Selection for training is by an interviewing panel under the chairmanship of one of the industrial Governors of the College, supported by a Technical College Principal, one of Her Majesty's Inspectors with relevant specialist qualifications, a representative of the University of Leeds Institute of Education of which the College is a constituent College, and a specialist senior member of the College tutorial staff.

2 The pre-service course is normally for one academic year but at the interview stage about one-third of the candidates are recommended for a four-term course. The first term is undertaken at the College of Technology during the summer vacation before the normal one-year course begins. It is an intensive course designed for individual students whose technical knowledge needs bringing up to date or whose laboratory and practical skills need developing. Probably all students could benefit from the four-term course if facilities were available. Experience of working with Commonwealth and Overseas technical teachers and technical institute instructors, indicates that one of their main needs is a similar type of intensive laboratory course in basic science to provide a background from which to select and demonstrate the application of scientific principles to the tools, machines, instruments, materials, processes, skills and safety procedures of their specialist occupations. Keeping abreast of the application of scientific technological development to construction, manufacture, maintenance, organisation and management, is a continuing professional need for technical teachers. It has been re-emphasised in a recent Department of Education and Science Circular[1] encouraging educational institutions to mount relevant refresher and extension courses.

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[1] GREAT BRITAIN. Department of Education and Science. Courses of further training for teachers in further education. 1966. (Circular 7/66.)

Content of Courses

3 The one-year course is guided by the special Board of Studies created for the College by the Leeds Institute of Education. Members of the Board include Technical College Principals, Heads of Departments and teachers, representatives from industry, from Leeds University and the central staff of the Institute of Education and Heads of Departments in the College. The course fits into the broad framework suggested in the McNair report on the training of teachers and youth leaders published in 1944[1]:

A. Education.

B. Teaching: principles of class teaching and the techniques of teaching particular groups of subjects.

C. Students: their interests, range of capacity, social environment, working conditions and general outlook.

D. Industrial and Commercial contacts.

4 The course in Education attempts to encourage critical thinking. The lectures, seminars, tutorials, visits to Schools and Technical Colleges and the guided reading focus on how educational ideas at particular times influence the development of education. The aim is to help students to understand that the structure and content of education in a country depends on the kind of society which its rulers wish to perpetuate or to create, and that educational opportunity and vocational choice in an industrialised society are closely related to its occupational, social and educational structure. They can appreciate the emphasis on longer full-time secondary education in mathematics, science and communication, as an essential preparation for vocational education and training. The students learn why there must be effective educational and vocational guidance by specially trained careers counsellors in schools, and by qualified training staff in industry. They realise the relationship between technical education and education as a whole. The necessity for regular re-appraisal of the pattern and duration of technician education and training makes sense, as do modifications to courses, and the reasons, for example, why day-release has been developed into block-release, sandwich or full-time arrangements. Comparative studies are made with other countries including Sweden, Russia, France, Germany, Holland, Italy and the United States. Students participate in projects involving visits to Europe and attendance at courses conducted in the College by experts from the Continent, Russia and America. They learn of the importance placed on the special knowledge of technical teachers and their ability to communicate it to others as an important element in the national economy of all countries. Appendix B of this paper includes some of the topics in the Education course.

5 There are two broad, interdependent divisions in the section dealing with class teaching:

1. General Principles and General Method.
2. Applied Principles and Special Method.

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[1] GREAT BRITAIN. Board of Education. Teachers and youth leaders, report of the Committee appointed to consider the supply, recruitment and training of teachers and youth leaders. London, H.M.S.O., 1944.

6 The general principles of teaching concentrate on the ways in which it is thought that adolescents and adults learn technical material and practical skills and on some of the factors influencing the quality of learning as evaluated by its application to occupational situations and to everyday living. The specific aim is to equip the students to become effective teachers in Technical Colleges. It can be a danger in a training institution for the specific aim in a general principles and general method course to become blurred and remote the longer tutors are out of contact with the people and educational processes in the field of technical education. Remoteness can result in a treatment of principles and method detached from situations confronting technical college teachers working with apprentices of varied abilities whose interest in learning varies over the spectrum from very keen through degrees of apathy to nearly antagonistic. An important feature of the principles course is the involvement of students in projects, case studies, assignments, role playing, investigations, analyses of situations and experience, and discussion groups. These devices encourage students to have more dynamic, imaginative, creative interest in less formal methods of their direct involvement in tackling real problems. They are keener to learn and readier to accept advice from tutors. They grow in self-confidence, in self-respect and in quality of personality. Factors such as intelligence, aptitude, temperament, heredity, environment, attitude, interest, become meaningful when they are related to the maximum/minimum intelligence range, profile of aptitudes and temperament, home background support pattern, framework of attitudes and interests of apprentices. By personal involvement in apprentice learning situations even in simple, elementary ways, students can be introduced to more sophisticated situations requiring study of the relevant literature. Not all students are interested or capable of a penetrative study of the factors in learning and achievement. Most mature students, like most mature adults, recognise and accept their limitations and they work within them to get and to give satisfaction in their jobs. At the same time they are suspicious and sceptical of the regurgitation of inadequately digested textbook information in lectures which, in their preparation and presentation, reflect no understanding of individual differences or students' professional objectives. They remain unconvinced of the relevance or value of tutorial group discussion for discussion's sake particularly if it is based on a kind of home-spun philosophy of education and human behaviour. The technical teacher trainer requires the knowledge of principles, and the experience of technical teaching and industrial training, to orientate methods to the changing pattern of courses in technical education. He needs the knowledge to argue reasoned, objective judgements about his personal acceptance or rejection of different methods of teaching and for his views about class management, discipline, class activity, informal methods, audio-visual aids, programmed learning, closed-circuit television, testing, examining, teacher-learner relationship, students' unions, staff-student councils, library and general studies, authoritarianism and autocracy in the classroom and technical college. His purpose is to stimulate question and challenge of attitudes, prejudices, opinions, knowledge, quality and value of experience, to encourage critical thought and flexibility of mind, the free uninhibited exchange of ideas, and the advancement of knowledge within a valid framework of principles. Appendix C of this paper gives topics dealt with in general principles.

Special Method

7 The special method course presents most difficulty. It is concerned with the interpretation and application of educational ideas to the circumstances immediately concerning technical teachers. Its purpose is to equip the student to become a good practitioner in a specialist department of a technical college. It is the sector in which the relative lack of information, training experience, literature and research is most felt. It is the department for which it is difficult to recruit tutorial staff. There are more requests to the College for special method assistance on technical teachers' courses organised by other bodies than for all other parts added together. Short special method courses arranged in the College are invariably over-subscribed. A perennial discussion among technical college teachers revolves around whether the science and technology in technician courses should be taught by science graduates without technical qualifications or industrial experience, or by technicians having limited formal education in pure science. It is a fruitless argument. The solution might be in the recruitment of technicians who could be given an intensive laboratory course in pure science, or in the recruitment of scientists who could be given an intensive workshop course and appropriate industrial experience. There can be no precise dividing line. Experiments are being conducted in the College with both schemes. However the knowledge and experience is integrated there remains the need for special method courses. The present system is for construction and engineering students to attend a short intensive preliminary course in general methods of teaching science and mathematics. The topics in the science course are given in Appendix D of this paper. On completion of the general course the students work in special groups with specialist tutors. It is an arrangement which permits of maximum use, not necessarily the best use, of difficult to recruit special method staff with the technical qualifications, responsible industrial experience and successful specialist teaching experience in a technical college department. It probably perpetuates the weakness of an over-fragmentation of tuition which characterises some technical college courses by having so many teachers involved that the apprentice thinks in terms of isolated, different subjects and not of an integrated course. It reduces the possibility of making a sensible synthesis of the different elements in the technical teacher training course. Within reason, it is probably true that the fewer the teachers involved in any learner's specialist education the more integrated, rational and effective is his learning likely to be. This thesis may be carried too far in some continental technical institutions but it does appear to produce an energetic learning atmosphere in colleges and training centres.

8 Experience shows that the energising influences in technical teacher training come from the tutor with up-to-date knowledge of the ways in which adolescents and adults can be motivated to make the personal effort to learn and who researches on ways to teach his subjects, who maintains his specialist knowledge of industrial practice and who is able to communicate with young people. He can extend general principles to precise statements of lesson aims and objectives. He can give relevant guidance on the selection and analysis of learning material. He can pin-point how technical education is co-operating with industry to produce more goods of higher quality, at a cheaper price, in a shorter time, supporting the economy, raising standards of living at home and abroad, developing the character and personality of apprentices by equipping them with

the occupational knowledge to give and to get satisfaction in the quality of their daily work and to be significant individuals with status in a technological society. More specifically, he can extend analysis of teaching material for class presentation. For example, in dealing with tools, instruments, machines, components, he can help students to think through purposes and design, principles of operation, construction and assembly, functioning and use, care and maintenance. He can help students to concentrate their teaching on special sections whether it be maintenance, fault finding and diagnosis, repair, design, manufacture, inspection or installation. He knows which audio-visual aids are useful. He knows how to demonstrate the application of the relevant scientific principles. He can advise students on learning difficulties to be anticipated, and how to deal with them at different stages in technician courses.

9 Much of the special method study is of a project and assignment type undertaken in the College laboratories and workshop and the adjacent library. Some projects are conducted in technical colleges with the help of teachers in specialist departments acting as advisers, consultants, providers of information and assessors of the teaching value of projects. The teacher training emphasis on laboratory, workshop projects to illustrate the application of principles to the equipment and processes of industry is relevant to the new technician syllabuses which require a close integration of theory and practice. Teachers in technical colleges are likely to be concerned less with teaching craft skill. This is raising a problem as yet hardly recognised, of the limited science and mathematics knowledge, laboratory and demonstration skills and industrial background of some technical teachers to deal effectively with much of the new technician courses. The problem can be tackled and solved with the development of suitable courses for technical teachers. It is the kind of adult re-education and re-training exercise with which industry is becoming familiar and with which continental countries have been dealing for years. The recruitment of technical teachers is a serious problem in some Commonwealth and Overseas countries. Already the Commonwealth Bursary Scheme makes provision for Bursars to revise, extend and bring up-to-date their technical qualifications and to obtain industrial training and experience. It might be worth exploring the provision of a special unit to develop more concentrated shorter courses for more senior and experienced education staff in the Commonwealth. They could be the nucleus of technical teacher educators and trainers in their home countries. The same unit could arrange courses for trainers of industrial training and vocational guidance staff. It could be a centre of information about the application of research findings to the organisation and administration of technical education and training, to equipping practical rooms and to the methods and technology of teaching.

10 Special method courses are designed to reduce traditional type lecturing, to eliminate dictated note giving and fact memorising, to concentrate positively on active rational learning by informal methods based on individual apprentice learning effort, on the development and flexibility of his intellectual and manual skills, on understanding the scientific principles underlying the techniques with which the apprentice is concerned and is likely to be concerned in the immediate future whether it be in the design office, the test room, supervising, inspecting, planning and progressing, site or floor management, maintaining plant, operating specialist gear, practising high grade skills, supporting scientists or technologists in the laboratory or in the research, experimental or development departments. Some of the topics dealt with in special method courses are given in Appendix E of this paper.

The Adolescent

11 Students study adolescence for two main reasons: to help them to understand the apprentices they will teach, and to help them to appreciate their own strengths and weaknesses of adjustment to life and the consequent quality of their influence on people with whom they come into contact. They can learn how their own attitudes developed, the basis of their prejudices, the nature of their beliefs and the strength of their biases, feelings and reactions. As a consequence they could be more sensitive to the influences affecting the behaviour of young people, how they can become interested or apathetic to study and learning, aggressive, unco-operative and frustrated in technical college, how their attitudes can enhance or limit their achievements and their educational and occupational opportunities and satisfactions. A further important objective is to convince student teachers how the potential of many adolescents is underestimated due to adverse social factors and the limitations of their homes having inhibited their capacity for adequate self-expression in tests, examinations, interviews, discussions and in education and occupation selection and placement situations dependent upon techniques which measure verbal ability rather than abilities and aptitudes. They are introduced to recent researches which establish that many more young people are capable of learning more, to a higher level, more quickly, than was believed possible a few years ago. They understand the reasons: better social conditions and services, better quality teaching, in smaller classes, by better educated and trained teachers engaged on a more suitable curriculum, using better teaching methods in a less authoritarian atmosphere. The students learn about the ambitions, the values, the problems which are more important to adolescents than their studies; relations with other boys and girls in their age group; economic independence; emotional emancipation from parents, teachers, foremen and other adults with control over them; meeting and selecting a mate; occupational success; marriage, a home and starting a family. The study can provide intellectual and emotionally maturing experiences for adult students who have decided to change jobs, taking them out of their familiar surroundings and established groups into another environment with different groups probably having different socio-economic ambitions and goals, values, standards, attitudes and way of life. The study is worthwhile if there is increased awareness of the significance of the human relations affecting the learning environment in the technical college and of the educational and personality consequences of their quality. Appendix F of this paper gives an indication of the course work in adolescence.

Speech and Delivery

12 Every student attends a practical course on speech and delivery. The tuition is mainly individual or in small groups. Experiments are at present proceeding with different methods of tackling this subject. One of the activities proving to be more successful than others is based on free movement and free activity in small groups participating in various forms of free drama. Each term each tutorial group writes and produces a short play in which all students participate. Variations on debating technique are used to encourage student self-confidence.

As many students as possible are encouraged to give a formal lecture to the whole College on a particular personal interest, or experience in an unusual technical specialisation, or on an issue about which an individual feels strongly. It is a popular activity which is appreciated by those attending the lectures. Introducing and thanking visiting speakers, expressing appreciation to hosts at the end of an industrial visit, participating in student committees, speaking at union and staff-student council meetings, leading discussion groups and participating in poetry-reading groups are all devices with the same objective, of building self-confidence and relaxed attitudes needed for adequate communication. Short talks and practice lessons involving demonstrations and illustrations seem to be useful techniques provided they are not overdone to the point of boredom.

General, Liberal, English Studies

13 The objectives in this area of the course are probably four-fold. The first is to attempt an assessment of the main weaknesses in the student's background of general education and to provide opportunities for development of the attitudes and interests to benefit from educational opportunities during his teaching career. The level of the students' qualification does not appear to be a criterion of intellectual sensitivity or capacity for understanding and using the skills of effective communication or for wise manipulation of people and situations. Perhaps too many graduates and equivalent professionals are educated and reared for too long and too remotely from the world of affairs and of earning a living to have learned from experience how life is lived by most people. The attempt in the technical teachers training course is to use the educational opportunities deriving from the cross-section of students from many walks of social and industrial life to create opportunities for them to learn from one another.

14 The second objective is a consequence of the first. It is comparatively easy to study background weaknesses but it is difficult to be constructive in their treatment. Rightly, there is not agreement about the exact content or best methods of providing a general, liberal studies course in a technical teacher training programme. Agreement would be a contradiction. There is general acceptance of the thesis that every subject and every tutor should encourage question and challenge of ideas. Translating agreement into practice is difficult. Not all tutors are willing to debate between themselves and with students their different opinions about the aims, meaning, philosophy and purposes of education, science technology and industry, or the foundations for views on the uses and misuses of psychology in technical teaching, or to justify firmly held prejudices about the sociological advantages claimed for particular kinds of educational and industrial organisation. Not every tutor is aware of, or willing to accept and to tackle the shortcomings in his own background of education and experience. The subject Education itself can be treated in a fragmentary, factual, elementary, information-giving way by experts riding particular hobby horses and consuming students' time rather than provoking their thinking. Equally, it can be a tendency of some special method tutors to assume a dichotomy between the subject matter of the Education course and the techniques of teaching. Others make heavy weather of the need for a knowledge of literature when the need is already appreciated by students. Still others, depending on

their own interests and expertise, would have separate studies of art, music, drama, grammar and the skills of writing. All are important and desirable. The problem is to be objectively selective, bearing in mind the duration, purposes and framework of a teacher training course of one year's duration. It may be that Education as a part of a teacher-training curriculum cannot be a disciplined study like mathematics or science and that like construction, building, medicine it is a synthesis of special subjects, syllabuses, schemes of work whose liberal content and influence depends on the intellectual calibre, personal culture and human understanding of the individual teachers and tutors concerned.

15 The third aim is to encourage the student to help himself by providing opportunities for him to extend his personal background. The scope depends on the special interests of the tutors and students and their willingness to share their interests and to give time to the corporate life of the College. The activities are varied and alive, as would be expected from adults who have decided to change their careers in industry for technical teaching largely because they prefer to be involved with people rather than things. On the whole, the students tend to be over-conscious of their limitations in general education and to over-emphasise the intellectual significance of book learning and the interest patterns of colleagues and tutors who have had an academic type of education. They soon learn to use libraries, to listen to music and to participate in drama, to paint a picture or throw a pot, to start on a foreign language, to make a start on elementary economics and to be more concerned about the philosophies and ways of Governments and of the background to world and home affairs. It becomes clear to them that they did not lack ability to study outside their special subjects but rather that opportunities were not available. The course will have been worthwhile if only a few of them convert into practice their good intentions to participate in liberal studies programmes and student corporate life in the technical colleges.

16 The fourth aim is to prepare a small group of teachers for the general subjects element in technician schemes of work. At the present time much of the work is exploratory. The students work closely with the specialist technical groups to think out the kinds of courses that could be useful, applicable and interesting in the lives of apprentices. It is an area of teacher education and training that requires much more research and experiment than has been given to it.

17 The kinds of questions posed and discussed at the tutorial staff study groups are included in Appendix G of this paper.

Teaching Practice

18 A third of the training year is spent on teaching practice in one or two technical colleges either for a full period of twelve weeks or for two periods of six weeks. The idea is that the student can feel he is a member of a technical college department doing a professional teaching job. He is committed to a progression of work with responsibility for class records and note books. He can conduct small investigation and case studies on topics previously agreed with tutors and technical college staff. He can participate in the corporate and social life of the technical college. The main purpose of the practice is that the student should gain experience of applying, putting into practice and using what he has learned in College. Students are not expected to spend more than about a day observing one technical teacher at work. They are expected to make fairly detailed studies of laboratories and workshops in their own specialist departments and less detailed observations in other departments. The kind of things they are asked to learn about include the reasons for a particular kind of design of practical room and the types and kinds of specialist equipment which are in it; who makes the choices and how they are arrived at; who decides what will be rejected, and why and when; who is responsible for placing and progressing orders, receiving, checking, storing, allocating, servicing equipment; the details of practical room organisation and management including the safety precautions built into practical courses; the extent and form of records maintained by teachers and apprentices in the different stages of a technician course; the programming of practical work. A tutor is allocated to the same group of students for the full teaching practice period. Students are advised in advance of the tutor's visit so that the lessons can be prepared adequately as a basis for a discussion on the value, relevance and education of the lesson material and method of presentation and of assessing classroom, laboratory, workshop, teaching organisation, class management and skills. The tutor discusses the student's file of previous lesson preparations and self-assessments in order to help the student to develop some originality and variation in his methods, to streamline the content to essentials and to be self-critical of the value of achievement in each learning activity. He discusses the observations which the student has recorded about teaching techniques and forms of organisation and management which have impressed him; about apprentices and how they react to different devices, methods and situations, to different teachers and different subjects, to technical college organisation and management. Appendix H of this paper gives an example of a memorandum used by new tutors from which to advise a student about a particular lesson and to help the tutor to arrive at an assessment on a five-point scale. The student is given a carbon copy of the detailed, item-by-item, progressive observations made by the tutor during each lesson observed. The purpose is to avoid meaningless generalisations and woolliness on the part of the tutor, and to commit the tutor to a point of view which can be the basis of relevant, worthwhile discussion and student guidance and progressing. The actual assessment is incidental to guidance. The tutor's function contains no element of inspection.

Students' Records and Reports

19 There is no formal examination at the end of the course of training. The University of Leeds Institute of Education is the body responsible for the content and structure of the College courses and for the final award of the Graduate Certificate in Education to University Graduates or the Certificate in Education to non-Graduates. The Institute is responsible for the validity and standards of the progressive assessments made by the College staff. The responsibility is exercised by the appointment of two external examiners for college course work and five external assessors for practical teaching. The examiners are usually a Professor of Education or a person of similar standing and the Principal of a Technical College. The examiners visit the college for three days during each term. They examine students' work and records. They observe students at work. They interview students individually and in specialist groups. They discuss individual student assessments with tutors and at the end of the session submit a report to the Institute. The practical teaching assessors are senior members of the Institute of Education central staff and of Colleges of Education within the Institute. They see about one-third of the students in their practising Colleges.

20 Each tutor maintains fairly detailed progressive records of his particular group of students and Heads of College Departments co-ordinate the various assessments. Appendix I of this paper gives the perhaps over-detailed schedule from which final reports are compiled and from which possible employers' references are compiled. With a system of progressive assessments of session examinations it is proper that the fullest information should be maintained and recorded in order that valid appraisals, comparisons and judgements can be made. The schedule is also intended as a guide to new members of staff about the kinds of things to which their attention should be directed.

In-Service Technical Teacher Education and Training

21 The pattern of in-service training for serving teachers in Further Education includes:

1. Sandwich courses of two main kinds.
2. One-term courses.
3. One day a week courses.
4. Full-time one month to six week courses.
5. Week-end courses.
6. Evening courses.
7. Vacation courses.

22 The courses for part-time teachers are mainly in the evenings or at week-ends.

23 The established sandwich course requires full-time attendance at the College of Education (Technical) for tbe first and fourth terms of a four-term course. During the middle two terms the teacher is in his parent College. He is visited regularly by a tutor. He returns written work, for example short essays on prescribed topics; book reviews; comments on official reports or on significant articles in particular journals or the general press. He also completes two long studies; one in Education and one in Special Method. Teachers must satisfy the admission qualifications of the Leeds Institute of Education if they are to qualify for the Institute's award. Teachers can be accepted without the stipulated qualifications but they do not qualify for the Institute's award. Teachers are accepted on the recommendation of their Principals and without further interview. They follow the same courses of study, and they are examined and assessed in the same way as pre-service course students. Four-term sandwich courses are arranged in the Spring, Summer and Autumn terms. A different kind of in-service sandwich course is due to start in the autumn of this year. It will be for one-and-a-half days a week for two years at an extra-mural centre staffed by the College with the help of serving technical teachers in the region of the centre. There will be one full-time period of eight weeks or two of four weeks either in the College or in the extra-mural centre. Admission qualifications, external examination and assessment will be as for pre-service courses leading to the Institute of Education award.

24 The one-term course was the forerunner of the sandwich course. Probably because it did not lead to a nationally recognised award it did not make a great appeal to teachers. Teachers are still accepted on one-term courses at the same periods as the sandwich courses are conducted. Explorations are proceeding with regard to reshaping one-term courses. For several years the College has conducted one day a week courses on an extra-mural basis. They have not been very successful. The recruitment to them is too small and varied in specialisms to make the tuition fully relevant and worthwhile. The tendency in such circumstances must be to concentrate on generalities. The exceptions are where a specialist College, for example a College of Building or one department in a College, has requested the course and supports it. There could be a future for specialist courses of the one day a week type.

25 A recent Department of Education Circular, already referred to in paragraph 2, emphasises the need for in-service technical teachers to extend their knowledge of subject matter and industrial practice in relation to recent scientific and technological developments in industry and in the technology of teaching and teaching methods. The first course in the College is due to start in January. It is to be Modern Mathematics in Technical Education. There is no doubt of the need for such courses. Their success will depend on the nature of investigations conducted in technical colleges in order to make courses specific. There is a place for a small research unit to guide the preliminary investigations on which to base short specialist courses.

26 Week-end courses in College or on an extra-mural basis are usually for specialist teachers or for a specialist activity. They are arranged either by, or in association with, one of the Regional Advisory Councils for Further Education, a Local Education Authority, a particular technical college, a professional body or organisation. An annual Conference for Heads of Departments is arranged by the Yorkshire Council for Further Education. The course organiser is a College tutor. Programmes and papers for some of the conferences are available in College. Other Regional Advisory Councils arrange similar courses and conferences in their own regions.

27 Evening courses for full-time, part-time and prospective part-time teachers have long been a feature of technical and further education. Normally the courses are arranged by Regional Advisory Councils. The College tutorial staff has a heavy commitment with such courses. They serve a useful purpose. Some courses lead to the City and Guilds of London Technical Teachers Certificate. Technical teachers and instructors who attended two successive summer vacation seminars in Ibadan were accepted as candidates for the City and Guilds Technical Teachers Certificate; full details of the seminars are available in the College. Other Commonwealth countries have prepared and entered teachers for the City and Guilds Technical Teachers Certificate. Vacation courses for technical teachers by various bodies including the Department of Education and Science, are well established. The contribution of the College is by its Summer School. The most popular courses in Summer School are those dealing with methods of teaching in technician and office arts subjects. Technical teachers are keen to attend courses in special methods of teaching their specialist subjects. A newly-appointed full-time technical teachers course of two weeks duration during the Summer School recruits its maximum quota of 150 year after year.

Other types of courses

28 The Governing Body of the College has always considered it sensible to provide courses for school and industrial staff directly associated with technical and further education as one way of bridging the transfer from school to work and further education. One-term courses for careers masters in Secondary schools were pioneered in the College. They were well supported. They have now been transferred by the Department of Education and Science to a College of Education preparing teachers for schools. A personal view is that there is much to be said for providing courses in the same College for the personnel in all agencies concerned with adolescents, whether as technical teachers, careers masters, counsellors, youth employment officers, youth service staff or industrial training staff.

29 Three courses a year are provided for Industrial Training Officers. They are on a sandwich basis of three periods of two weeks in College with the intervening periods of four weeks back in the parent firms where the Training Officers are visited by tutors to progress and advise on projects and to discuss specific training problems and techniques. A Board of Studies consisting of practising Training Officers in Industry advises the College staff on the content of the study programme, its staffing, teaching methods and evaluation techniques. A close working contact is maintained with the Training Boards. Regular short courses are conducted at week-ends and in vacation time for Instructors from industry.

Research

30 Since its founding, twenty years ago, the College has been actively engaged in educational research. There is a research committee with representatives from four University Institutes of Education, two Regional Advisory Councils for Further Education, from Technical College staffs and from industry. The major projects at present include the preparation, trial and evaluation of schemes of work in science and mathematics for General Courses; a study of the education and training of electrical engineering technicians; a similar project for technicians in the chemical industry; programmed learning in technical education; examinations; course work and progressive assessment in building technician courses; comparative studies of technical education and training in other countries. The general science and mathematics projects involve about 100 technical college teachers working with College staff and a number of H.M. Inspectors. Several weekends were spent drafting the schemes of work for class and laboratory work. A week full-time at College this summer vacation was devoted to modifying the material which is to be tried out in a number of technical colleges in the coming session. Other projects have been undertaken by College tutors granted a sabbatical term for the purpose. Reports on the projects are available in the College. A project on Team Teaching for the first years of an Engineering Technician Course has been organised by a tutor with the co-operation of the Principal and staff at Bradford Technical College where the experiment is being conducted. A team of tutors is exploring the factors influencing technical teachers' effective communication in an attempt to develop more realistic training courses and devices. A number of tutors are studying for higher degrees in Education within areas of Technical and Further Education which interest them.

31 Because of the limited amount of readily available reference material on technical teacher education and training there is probably a greater impetus for tutors in the College to identify areas in which they can carry out group or individual small-scale investigations which in themselves probably contribute at least as much applicable information as the more highly organised work. Amongst the smaller scale studies are: attitudes of part-time students to technical studies; the analysis of various technician syllabuses and the devising of suitable experiments and demonstrations; constructing schemes of work for new kinds of courses; methods of evaluating technical teaching and instruction and of assessing achievement; ways of integrating theory and practice and co-operation with relevant sectors of industry; ways of training laboratory and workshop technicians for technical colleges. Reports on small scale investigations are available in College.

32 The Leeds Institute of Education and the College are mounting a course for a newly created Institute Diploma in Further Education which will be organised on a four-term sandwich basis for senior staff in Colleges of Further Education, Training Officers from Industry, administrative and Secondary school staff. For those completing the course successfully there are likely to be opportunities to extend studies for a higher degree. They could give the stimulus and guidance needed by teachers for small-scale, short-term investigations in the technical colleges. It is the kind of course which might be worthwhile for some senior staff from Commonwealth countries. Technical teacher training was slow to start and slower to be developed than it should have been. It has probably reached a stage when it could be worthwhile to reappraise and evaluate its objectives, organisation, curriculum, methods, staffing and further development.

APPENDIX A

Huddersfield College of Education (Technical)

Special conditions for admission

1. Age: Not less than 25.
2. Technical qualifications: as in following list.
3. Experience: good relevant experience, normally in industry or commerce, including experience in a position involving responsibility or a high degree of competence.

Technical Qualifications for Admission

General

1. Only qualifications gained by examination can be accepted.
2. The following qualifications in appropriate subjects may be accepted:—
   Degrees obtained at United Kingdom Universities.
   Diplomas in Technology.
   Full Technological Certificates of the City and Guilds of London Institute.
   Higher National Diplomas and Certificates.
3. The Department of Education and Science, London, will be glad to advise on the acceptability of degrees and other qualifications gained outside the United Kingdom.
4. A final Certificate of the City and Guilds of London Institute is acceptable only in certain cases.

Engineering

University Diploma in Mechanical Engineering or Electrical Engineering.
Associate or Graduate Membership of the Institution of Mechanical Engineers.
Associate or Graduate Membership of the Institution of Electrical Engineers.
Associate Membership of the Institution of Civil Engineers.
Associate Membership of the Institution of Structural Engineers.
Associate Membership of the Institution of Chemical Engineers.
Associate Membership of the Institution of Production Engineers.
Associate Membership of the Institute of Marine Engineers.
Associate Membership of the British Institution of Radio Engineers.
Associate Membership of the Institute of Gas Engineers.
Extra First Class Certificate for Engineers (Ministry of Transport and Civil Aviation).

Building

Associate Membership of the Institution of Civil Engineers.
Associate Membership of the Institution of Structural Engineers.
Associate Membership of the Institute of Municipal Engineers.
Associate Membership of the Royal Institute of British Architects.
Associateship or Licentiateship of the Institute of Builders.
Associateship of the Royal Institution of Chartered Surveyors.

Commerce

University Diploma in Public Administration.
Solicitors and Barristers.
Associateship of the Association of Certified and Corporate Accountants.
Associateship of the Institute of Cost and Works Accountants.
Associateship of the Institute of Chartered Accountants.
Associateship of the Society of Incorporated Accountants and Auditors.
Associateship of the Institute of Bankers.
Associateship or Licentiateship of the Chartered Institute of Secretaries.
Associateship of the Corporation of Certified Secretaries (Commerce group and Local Government group).
Associateship of Chartered Insurance Institute.
Associate Membership of the Institute of Transport.

Clerical Arts

Advanced Certificates in Shorthand and Typewriting, together with either:

(*a*) R.S.A. English, commercial subject or foreign language at Stage III.

(*b*) G.C.E. 'A' level in two subjects including English, or

(*c*) G.C.E. 'O' level in five subjects, including English, with evidence of organised further study in English or other appropriate subjects.

Bakery

Higher National Bakery Diploma.
National Bakery Diploma.

Catering

City and Guilds Final Certificate No. 152 and Membership of the Hotel and Catering Institute.
*City and Guilds Final Certificate No. 151 after completion of a full-time course at a technical college.

Mining

Associateship of the Royal School of Mines.

Associate Membership of the Institution of Mining Engineers.

Colliery Manager's Certificate 1st Class.

Colliery Surveyor's Certificate 1st Class.

Honours Class Certificate of the Association of Mining Electrical and Mechanical Engineers.

Nautical Subjects

Extra Master's Certificate.
Master's (foreign going) Certificate.

Painting and Decorating

National Diploma in Design in Decorating and Signwriting or Interior Decorating with Final Certificate of City and Guilds.
Associateship of the Institute of British Decorators with Final Certificate of City and Guilds.

Printing

Qualifications of the order of City and Guilds Full Technological Certificates.

Science

Associate or Graduate Membership of the Royal Institute of Chemistry.
Associateship or Licentiateship of the Institution of Metallurgists.
Associateship of the Institute of Physics.
Associateship of the Plastics Institute.
Associateship of the Institution of the Rubber Industry.

Tailoring

City and Guilds Final Certificate in Advanced Ladies Tailoring.
Full Technological Certificate in Clothing Technology.

Textile

Associateship of the Textiles Institute.

Women's Trades

Institutional Management Association Certificate.
City and Guilds Final Certificate in Advanced Domestic Cookery.
City and Guilds Final Certificate in any of the following: Advanced Dressmaking, Millinery, Needlework, Home Upholstery and Soft Furnishings, or Hand Embroidery.
Diploma of Royal School of Needlework.

General Subjects (English, Foreign Languages, Economics and Sociology, Geography and History).

University Diploma.
H.S.C. or G.C.E. 'A' level in at least three subjects, provided it is accompanied by evidence of subsequent study and the applicant has had appropriate experience (not necessarily industrial and commercial).

Management Studies

Associate Membership of the British Institute of Management or the Institute of Industrial Administration.
*Graduate Membership of the British Institute of Management.

Note:

* Candidates possessing these qualifications should be accepted only if they have had particularly good relevant experience in industry or commerce.

APPENDIX B

Huddersfield College of Education (Technical)—Topics in the Education Course

Different amounts of time are allocated to each subject.
Not all students study the same subject at the same time.
Not all students study all the subjects.
Subjects are not studied in the same depth by all students.

Lectures are the starting point for discussion groups, tutorials, projects and long studies. College lectures and discussions are in most cases supplemented by talks and discussions led by visiting specialists and by visits to educational, industrial, community institutions, and by library study, projects and written work.

1. Making and arranging personal notes and files of information.
2. Aids to study.
3. Using the College library.
4. Clear thinking.
5. Background to the Education Acts before the 1944 Education Act.
6. Nursery and Infants Schools
7. The Primary School

   aims, history, development, methods, curriculum.

8. Transfer from Primary to Secondary Education: the rise and fall of selection by examination at 11+ for allocation to different types of secondary schools having different histories, traditions, aims, curricula, organisation, staffing, financial arrangements.
9. The Secondary Modern School: aims, history, changing development, and curriculum; extended courses; vocational courses; curricula; background and consequences of raising the school-leaving age; possible impact on the organisation, courses, syllabuses, organisation methods and further education and retraining of teachers in technical and higher education.
10. The History of Secondary Technical Education from the Junior Technical School to the Comprehensive and Bilateral Schools
11. The Secondary Grammar School
12. The Comprehensive School
13. The Bilateral School
14. The Independent School
15. The Public School

    The philosophies behind the arguments relating to the establishment, disappearance, continued existence of the various types of secondary schools.

16. New approaches to curriculum building in secondary schools and the possible impact on the nature of the work and the kinds of teachers required in technical colleges.

17. The Nuffield Science and Mathematics Projects and similar experiments in Secondary education.
18. Experiments in Secondary education.
19. The history, aims, development, organisation, administration of Technical and Further Education; a general treatment up to the year 1850, more detailed until 1959 and with increasing detail up to the present time and in relation to developments immediately concerning teachers in technical colleges and colleges of further education. Much of this course is dealt with by visiting speakers, by visits to different kinds of colleges and departments, by projects based on relevant reports.
20. The history of the growth of selected technical colleges.
21. The organisation of particular kinds of colleges including Regional, Area, Local, Branch, Works-based colleges.
22. The development and purposes of Regional Advisory Councils for Further Education.
23. Examinations in Technical Institutions (history, administration; Regulations for National Certificate Courses; City and Guilds Courses; Union of Lancashire and Cheshire Institutes and similar bodies in technical and commercial education; the changing patterns of examinations and final assessments for qualifications and the consequent need for further education and training of technical college teachers in the principles and methods of record compilation, maintenance and interpretation and of the techniques and tools of course work assessment).
24. The purposes of the relevant professional institutions.
25. Manufacturers' and Employers' Institutions, Federations and organisations.
26. The Trade Union movement.
27. History, development, organisation and methods of education and training in industry.
28. The Training Act: Training Boards and their possible impact on technical and further education: training centres in technical colleges: the training of instructors in technical colleges.
29. The different purposes, techniques and levels of liaison between the staffs of colleges and industry and commerce.
30. The structure, organisation, basic occupation pattern of industry and business.
31. Vocational and Educational Guidance principles; devices; tools; techniques; practices; experiments; teachers progressive records of abilities, aptitudes, personal development, achievements, inventories; interviewing; tests and testing for different educational and vocational purposes; the careers teacher; the industrial training officer.
32. Training, retraining, accelerated training of adult workers at all levels of industry and business.
33. The Youth Employment Service: aims, history, development, organisation, administration, recruitment and training of its officers, record system, reports, work in schools and with industry, research reports.

34. The Youth Service: aims, history, organisation, development, voluntary bodies and other agencies; official reports, current researches.
35. The Administration of Technical and Further Education: central, regional and local organisations.
36. Education in Greece
37. Education in the Roman Empire
38. The Reformation and Education
39. Education in England in the 17th century
40. Education in England in the 18th century
41. Education in England in the 19th century

Very general treatment to convey ideas of the relationship between the underlying philosophy, organisation, curriculum, methods and practice of Education.

42. Some of the Philosophers: Plato, Aristotle, Voltaire, Rousseau, The Jesuits, Kant, Marx, Pestalozzi, Dewey, G. S. Hall, A. N. Whitehead, A. S. Neil.

APPENDIX C

Huddersfield College of Education (Technical)—Topics of the General Principles Course

The aims of the course include:

1. To provide the basis for immediate reading and library study.
2. To give a basis from which to start thinking and discussion about technical college students studying for vocational qualifications.
3. To persuade students of the need to apply teaching principles which encourage individual interest and learning effort.
4. To encourage students to experiment with ideas, methods and devices to make their teaching effective.
5. To develop the attitudes and skills to identify teaching errors and to produce techniques aimed at reducing the consequences on learning.
6. To convince students that they should be spending much of their time in the College laboratories and audio-visual aids rooms practising their speech and delivery, handling visual-aids apparatus, setting up practice lesson demonstrations in the laboratory and classroom, making pictures, slides, diagrams, models, film strips, and using tools and materials (wood, metal, plastic, glass) to make the devices needed for effective presentation of technological lessons.
7. To help students to prepare lessons and to appraise the quality of several different forms of formal and informal presentation.
8. To give the students a background from which to tackle their day-to-day personal, classroom and professional problems.
9. To lay the foundations on which students can learn to collect, select, organise and arrange teaching material for presentation to technical college students of different ages on different kinds of courses for different reasons.

The topics include:

1. The learning principles involved in the preparation and presentation of technical material: evaluating learning in terms of ability to apply and use knowledge and information : incentives and motivations as they can influence learning effort, interest, attention, persistence, success; kinds of learning involved in character building, personality development, in learning practical skills, theory and general subjects.
2. Factors in learning: general intelligence, its nature, measurement, effective intelligence, correlation with kinds of learning, kinds and levels of courses in technical colleges; aptitudes, their nature and measurement and relevance of aptitude profiles to courses in technical colleges; heredity; environment; motivation; background support; industrial support; experience; health; personal qualities; quality of teacher; quality of teaching.

3. Individual differences: grouping and streaming.
4. The literature of learning; researches into ways of learning and the evaluation of learning.
5. Sources of teaching material: selection, arrangement and lay-out of material for lecture, lesson, discussion group, small tutorial group, individual tutorial, informal group activities; immediate, intermediate, long-term aims and objectives of the apprentices in the class is the significant factor in the preparation and structuring of teaching material; structure of the lesson period; ways of introducing technical subject lessons; maintaining even, steady, progressive flow and development of the subject matter and its learning; concluding the lesson; synthesising the information with earlier lessons and activities, with other sections of the course, and with the learner's industrial experience and needs.
6. Classroom conditions and class organisation: responsibilities of the teacher; ventilation, temperature, cleanliness, tidiness, registration, personal and student absences; control and management, class activity, participation and involvement: framing, uses, abuses, techniques of class questioning, encouragement of questioning and discussion by the class; discussion group technique.
7. Individual and group project and assignment planning and progressing to effective conclusions.
8. The place and methods of case study: role playing; dramatisation; learning games.
9. Short courses on the use of chalk boards, felt boards, magnetic boards: making charts and diagrams of different kinds for different purposes: making simple 'throw away' illustrative models in cardboard, wood, plastic, metal, glass: using components whole, in pieces, sectioned, exploded: the place and use of films and film strips for different purposes: the place and use of simulators: relevant radio and television programmes: co-ordination of all forms of illustration.
10. Evaluating teaching and learning: homework, questions, tests, assessments, examinations, interviews, tutorials, discussion groups, record cards, inventories, progressing, guidance, marking, using marks as individual incentives, validating marks and assessments: self-evaluation techniques for students to assess their own learning: self-assessment devices for teachers to evaluate the quality and success of their lesson preparation and presentation.
11. Organisation of technical college and teachers' responsibilities: personal records: students' records: progress charts: reports: administrative arrangements for examinations: college tradition, discipline, status, tone, public relations and responsibility of teacher: arranging educational visits to industrial organisations; preparation of students and receiving organisation; conduct of visit; report and follow-up; insurance; accidents; ordinary reception; storage, care and maintenance of equipment: inter-staff relationships: students' corporate life and contribution of teachers: arrangements for attendance at teachers' courses, further study for higher qualifications or to supplement existing qualifications for returning to industry for experience; facilities and grants for research.

APPENDIX D

Huddersfield College of Education (Technical)—General Method (Science)

1. Laboratory design; layout; organisation; management; teacher's and students' records; student progressing and guidance; projects and assignments for individual and group work; individual differences in laboratory work; evaluation and quality of learning from laboratory work; examining, testing, progressively assessing laboratory work; the duties and supervision of laboratory technicians as distinct from the duties and supervision of laboratory stewards; the sources of reference for laboratory studies; sources of information about equipment; the school laboratory as distinct from the technical college laboratory, and the college laboratory as distinct from the industrial laboratory; half-day visits in small groups to see different, well-equipped, well-managed laboratories in colleges near to Huddersfield.
2. Safety precautions; education and training in relation to Technical College laboratories for science, technology, specialist services; procedures and action in the event of an accident.
3. Aims and organisation of laboratory work to integrate with related topics and technology courses for craft, technician and technologist courses in different years of a course: (the danger in a Special Method course is to spend too much time on generalities at elementary levels instead of a steady forward progress through the syllabuses for each year of the course: the 'G' courses are overemphasised at the expense of third or fourth year courses in science).
4. Discussion of official reports; reports by professional bodies; by research organisations, e.g. Nuffield, on the content and methods of teaching laboratory subjects.
5. Discussion of examiners' reports for different levels of courses and in relation to laboratory work.
6. The content, methods, value, relevance to the specialist science teacher as a personally educative and training device of the programmes on television.
7. Programming laboratory work for teaching machine.
8. Devising laboratory programmes for closed circuit television in relation to particular parts of a scheme of work for different years of a course: visit to study and observe the preparation of a television programme in a technical college.
9. The analysis of common mistakes students make in the laboratory at different stages of a course and possible causes and remedies.
10. Small scale equipment in laboratories of different kinds.

11. Surveys of particular sources of information for specific sections of a course of laboratory work.
12. The place of film/film-strip in teaching laboratory procedures.
13. Accounts of researches which have been conducted and are in progress on the teaching of laboratory work.
14. Regular demonstrations by the tutor on the teaching of 'difficult' laboratory subjects.
15. Project by each student on the course, involving his participation in laboratory work.

APPENDIX E

Huddersfield College of Education (Technical)—Topics in Special Method Course

Each student has discussions with specialist tutors to agree on the subjects and levels which he is likely to teach in his first appointment. His special method courses are arranged accordingly. Normally a student studies two special method courses throughout the session. In addition he can attend one, but not more than two, additional shorter special method courses. He can attend only the courses for which he has the necessary technical qualifications. Opportunities exist throughout the session for individual assignments and tutorial guidance, to revise subject matter to the level required before starting on a particular special method course.

Topics

1. The mechanics of building a course and subject syllabuses for a technician course.
2. Principles and methods of expanding a syllabus and laying it out as a scheme of work; aims of the course as a whole; aims for inclusion of the special subject; trends and levels of industrial training and experience of technician apprentices for which the syllabus is intended; educational, industrial and social background of the apprentices; achievements in relevant school subjects; basis of selection for training and education courses, intelligence ranges, aptitudes, interests and personality profiles; attainment in mathematics, science, English and any additional subjects stated in admission regulations; types of tests for course and training selection procedures, administration and interpretation; induction courses and their organisation for revising and extending apprentices' basic subject knowledge before starting on the course proper; value and limitations of existing devices for selection, placement, guidance.
3. Detailed group projects in expanding relevant syllabuses to schemes of work; aims of the course re-examined; total time available and its allocation to formal and informal lessons; the aims in each lesson correlated and organised into a session's scheme of work; the salient facts and information in each lesson arranged progressively for the session; correlation of lesson information with the material being presented simultaneously in other subjects of the course and with industrial training and experience; the illustrative, audio-visual and other aids to be used in each lesson; methods to be used in evaluating success of teaching and learning in each lesson; homework correlated with lessons; library and other sources of lesson information for the teacher for each lesson and the library study references for apprentices.
4. Principles and methods of lesson preparation, structuring, laying out and presentation for different kinds of topics in the scheme of work.

5. Demonstration lessons by tutors and students.
6. Preparation and discussion of relevant demonstration experiments; chalk board and other board summaries and possible incidental material; charts and diagrams; models and components in different forms, assembled, exploded, sectioned, in pieces.
7. Techniques for dealing with the individual differences among apprentices in the same class.
8. Discussion of common learning difficulties and errors in teaching particular parts of the scheme of work; analysis of difficulties and errors; remedial techniques; demonstrations by tutors and other experienced specialist teachers.
9. A study of relevant reports (including examiners' reports) concerning the teaching of the subjects.
10. Researches being conducted into teaching the subject.
11. Marking theoretical, laboratory and workshop material.
12. Compilation, maintenance, interpretation, uses of apprentices' College records; reports for different purposes.
13. Laboratory, workshop, practical room organisation, management, supervision, safety education; ordering, storing, maintaining equipment; consumable materials; responsibilities of teacher, technician, steward, store-keepers, caretakers, cleaners, in the laboratory and workshop, practical room.
14. Tutor demonstrations and student practice in setting up and giving laboratory and workshop lessons.
15. Examination, discussion, appraisal for teaching purposes of reference material, text books, source books, journals, magazines and handbooks from professional and industrial organisations.
16. The uses of film and film-strips; selection; appraisal; method and timing of their use.
17. Discussion of effective and ineffective techniques and devices observed by students during teaching practice.
18. Examination and discussion of possible causes of wastage in the particular course and classes in which the students will be engaged; research reports; researches in progress.
19. Arranging and conducting special educational visits.
20. Involvement in industrial, school and other kinds of liaison to establish the need, value and methods.
21. Apprentices personal note books, files and other methods of building-up records of course work and other relevant information.
22. Discussion and in some cases involvement in team teaching experiments in technical college.
23. Skill learning; rote learning; habit formation; boredom and fatigue; analysis of skills; job analysis; factors involved in skill learning and methods of teaching; demonstration techniques; modern techniques with

audio-visual aids, simulators, off-the-job exercises and preliminary training and preparation; researches being conducted; teachers' and learners' problems of communication and ways in which they are being tackled; using apprentices' records and progress charts as a basis for individual guidance.

24. The contribution of technical subjects' teachers to the general studies programme; involvement by giving talks, leading discussions, participating in art, pottery, music, drama, poetry reading, and other non-technical activities.

25. Specialist teachers' attitudes to their subjects, teaching, apprentices, college, industry, local schools, the local community, corporate life of apprentices; teacher's function and responsibilities as a tutor.

26. The history, development, changes and future pattern of teaching the subject; lessons; lectures; tutorials, discussions groups; projects; assignments; audio-visual aids; programmed learning; closed circuit television; national, regional, local television and radio; simulators; correspondence courses; residential courses; morning, evening, week-end, vacation courses.

27. Safety education is a feature in all special method courses.

APPENDIX F

Huddersfield College of Education (Technical)—Topics Dealt with in Development in Adolescence

Students carry out a number of case studies in Technical Colleges, in Youth Clubs, and Industry. Some students extend their case studies into long essays. The studies are supported by guided reading from the relevant specialist literature and researches and a considerable emphasis is placed on reading modern novels and also seeing plays and films about young people. Teachers in schools and colleges, Youth Workers, Probation Officers and Industrial Training Officers, give talks and lead discussions. Groups of young people visit the college to express and exchange views.

Topics

1. Development in adolescence: intellectual, physical, emotional, social; the learning process: individual differences: influences on development: the craft apprentice: the technician apprentice: technologist student: the young semi-skilled and unskilled operatives: the normal adolescent apprentice: discussion studies of abnormal adolescents.
2. Heredity and environment in the development of adolescent students; the importance of home, school, college, working environments, parents, teachers, other adults in their lives.
3. Social and ocupational structure of society and industry and their influence on adolescent education and careers.
4. Development of attitudes: growth and pattern of vocational, social and personal interests, ideals, standards, values, ambitions, personality growth, changing roles, emancipation.
5. Constructing, interpreting, using sociograms; inventories; group techniques in studying adolescents.
6. Final years at school and transferring from school and adjustment to work and further education.
7. The Youth Service and other agencies concerned with young people.
8. Problems of social adjustment.
9. Delinquent and problem adolescents.
10. The literature of physical and social maturation and sex education for family living.

APPENDIX G

Huddersfield College of Education (Technical)—General, Liberal Studies, English

The kinds of topics dealt with in staff discussion include:

1. Is it possible to produce a progressive scheme in English for each group of students, depending on the educational background and qualifications, industrial training and experience, their individual differences and needs? If it is possible what diagnostic and remedial devices are used and how is the individual scheme of work decided, pursued, guided, progressed and evaluated?

2. Is the course aimed at more effective, selective, better informed understanding of specialists and general reading for students who have arrived in the College with qualifications varying from good degrees in subjects such as Economics, History, Languages, to craft or office arts qualifications in a skilled occupation?

3. Is a main purpose of the course to encourage self-expression and communication in speech? What different techniques, tests, remedial devices, syllabuses, schemes of work, audio-visual aids are possible which can be used in the attempt to extend what was achieved at school?

4. How important is a course of study in clear thinking in relation to, and in association with, the skills of writing and the skills of mechanics of clarity of expression, clarity of meaning, interest value in speech and delivery, clarity of communication?

5. Is it possible or even sensible, to attempt long-term remedial work in speech with adult student teachers? Should those in need have been admitted to training?

6. How far is inadequacy in self expression associated with personality difficulties which can be relaxed by relaxing techniques such as free movement, free drama, role playing?

7. What kind of guidance is given to all students with regard to the personality, social, educational background problems which can affect the capacity of some adolescents in technical classes to express themselves?

8. How do the English tutors in the College work with colleagues in local technical colleges and Industrial Education and Training staff, to collect information, exchange ideas and experiences, to sound points of view about the place of English subjects in technician courses and to give demonstrations on ways of encouraging interest in speech and self-expression?

9. What are the purposes of written work for the students? Should there be separate written work in English as well as Education and Special Method? What different purposes can it serve?

10. How can all tutors co-ordinate with the English tutors to help students in the preparation, presentation and communication of specialist material on teaching practice? Can English tutors advise colleagues about common weaknesses and errors amongst the student teachers?

11. What use is in fact made of less formal aids to communication? Do tutors co-operate to use drama, play reading, debating, discussion group, role playing, learning games techniques? Is every student involved with his Special Method group and Special Method tutor in participating in a one-act play each term?

12. Do the Special Method tutors arrange for individual students, who have particularly interesting contributions to make to general studies discussions, to give short talks, e.g. the ships' captains and engineers, aircraft pilots, Commonwealth and Overseas students, those who have been social workers and anybody with a different kind of experience?

13. What are the precise objectives in the Liberal Studies courses provided for the student? How do the objectives differ from those in schools and technical colleges?

14. Is there a tendency for English and Liberal Studies staff in the College to work in isolation from all other subjects and tutors? What are the reasons for this? How can the situation be remedied? Does the situation pertain in technical colleges and if it does how can it be changed?

15. Do tutors in all sectors of the College work need to have opportunities to broaden their cultural background, to raise their general education sights and to maintain intellectual awareness of the changing world situation?

16. How are decisions reached about student teacher projects? How far is the student given freedom of choice? How far is choice confined to the interests of the tutor? How far are topics allocated by a tutor in the light of his personal interests? If any student has no general interest is this not a reason for close investigation? Is it not a reason for research in relation to leisure activity and interest for adults in industry?

17. Is it necessary always for General, Liberal Studies projects to be a job of written work? Is there a place for projects taking account of the fact that technicians and craftsmen and their teachers need to be developing broad interests to discuss, question, learn about and maybe to understand a little better the purpose of living, the rights and responsibilities, the penalties and privileges, of being citizens in an established democracy, or whatever it may be that individuals are trying to live?

18. How does the Liberal Studies course deal with social changes consequent on changes in the pattern of industrial organisation and occupation?

19. How does the course prepare student teachers to think intelligently and in an informed way about the social, educational, occupational changes which will take place during the early years of their teaching lives?

20. To provide experience in collecting, selecting, sifting, accepting, rejecting, evaluating information and evidence in arriving at conclusions to be

tested and modified, the following kind of discussions involving different tutors and students could be useful.

(1) How can one deal with individual differences in one of the relevant technician classes?

(2) How can one teach a particular topic to a second year technicians' class on a particular course?

(3) What is meant by quality of teaching and quality of learning in technical classes?

(4) How can the learning of first year science and materials be made a liberal experience for the apprentices?

(5) What are the main kinds of discipline problems in a first (second, third, fourth) year technicians' course? What are the causes, possible remedies and ways of preventing them?

(6) What social factors influence the education and occupational choices and opportunities of young people leaving school at 15 or 16?

(7) What is the meaning of Personality? Can it be measured, assessed, modified, developed during middle adolescence? To what extent is the teacher of technical subjects likely to influence an apprentice's personality development during the two class periods a week for about 40 weeks of the year in which he meets him?

(8) What is meant by character, character building? Which ideas have conditioned character education throughout history? Can the technical subjects' teacher influence the quality of apprentices' characters in middle and later adolescence?

(9) How can the subjects in the second year technicians' course be co-ordinated?

(10) When should demonstrations by the teacher be used in preference to individual practical work in the laboratory or workshop?

(11) Can standards of behaviour be taught?

(12) What kinds of value judgements does a technical teacher have to make in the course of his work?

(13) What is meant by 'Walking the Corridors of Power'?

(14) What is meant by 'The Two Cultures'?

(15) What is meant by Democracy?

(16) What does a teacher mean when he says he is democratic but that colleagues are not democratic?

(17) Can a technical college be a democratic institution?

(18) Can a democratic group exist at any level of a technical education or industrial training institution?

(19) How phoney is any claim that a technical college staff can be 'democratic from top to bottom'?

(20) Do people involved in Education ever get close to the fundamentals of education or thinking or living?

APPENDIX H

Huddersfield College of Education (Technical)— Lesson and Teacher Assessment

The notes are intended to help tutors during teaching practice. A written appreciation of lessons is much better than a number of isolated headings. The notes indicate lines on which an appreciation can be made and teaching assessed. The dangers of inexperienced assessment are that the observer may be

(i) too analytical,

(ii) too general and abstract,

(iii) concentrate too much on the teacher and on simple idiosyncracies,

(iv) neglect the class,

(v) fail to be constructive.

The common tendency with less experienced assessors in lesson assessment is to neglect the evaluation and quality of class learning and to concentrate on the teacher's performance. The latter is obviously much easier. It requires only that the teacher be studied for personality, knowledge of subject, 'tricks of the trade'. Observation of the effectiveness of the teaching on the class is more difficult and requires greater skill. It presupposes a sound knowledge of learning principles and their application in the teaching situation. It also presupposes a knowledge of the aims in technical education, not only in relation to the subject matter, but also to the personality development and character building of students in the class. The following techniques try to combine some relevant factors.

Class:............................Duration of lesson:.................... Time:............................

Title of Lesson

Aim of Lesson

Teacher's Preparation—This should be seen before and after lesson.

Points to note include:—
General layout
Preparation of questions
Preparation of diagrams
Preparation of incidental sketches
Preparation of demonstrations
Preparation of experiments
Originality of preparation
Other aids to instruction.

Manner and Management—This is assessed as session proceeds.

Knowledge of subject
Confidence shown by pupils and teacher
Enthusiasm shown by pupils and teacher
Attitude to the class, particularly with those having difficulty in understanding
Leadership, particularly with less interested pupils
Liveliness of technique
Ability to convince pupils
Class contact in terms of co-operation by the pupils at all stages of the lesson
Purposeful movement as opposed to sloppy manner or irritating pacing about
Use of teaching notes
Posture
General appearance
Irritating mannerisms
Class control.

Voice and Delivery

Clarity of enunciation
Clarity of meaning
Volume
Speed of speech
Modulation
Phrasing
Interest value
Emphasis
Absence of verbal mannerisms.

Introduction and Development—Assessed during lesson

Suitability in terms of class, standard, subject, revision, creating interest
Relevancy in terms of showing worthwhileness of subject
Length
Interest and teaching value of introduction and development
Clarity of aim to class
Establishment of principles at each stage of lesson
Logical development and class co-operation
Speed and continuity of development
Use of questions to and from the class
Lucidity of explanation especially in establishing principles.

Illustration and Demonstration—Assessed during lesson

Teaching of verbal illustration
Teaching value of written and diagrammatic blackboard work
Content of blackboard summary and its value for pupils' notebooks
Layout of blackboard summary and its value for pupils' notebooks
Demonstration with blackboard
Demonstration with apparatus
Demonstration with models
Use of colour in blackboard work
Labels on diagrams as an example of neatness, accuracy and craftsmanship
Other illustrative aids
Timing of illustration in terms of blackboard work and lesson development
Co-ordination of blackboard work, speech and demonstration.

Consolidation—Assessed at end of lesson

Method used: questions, discussion, recapitulation, exercises
Progressive and final consolidation
Class activity during consolidation with emphasis on ensuring that 'learning can be applied'
Types of questions and their teaching value
Use of answers
Method of dealing with questions from class.

General Points—Assessed at end of lesson. This section is an attempt at an assessment of the teacher's reaction to his environment.

Punctuality in commencing and finishing
Attention to classroom routine, tidiness, blackboard, chalk, dusters, registers
Ventilation and temperature
Tables and desks clear of superfluous material, e.g. cases, coats, books
Seating—no gaps at front and in centre of room
Blackboard clean, chalk ready, dusters, box for pieces of chalk, pointer available
All class attending before teacher commences
Untidy and dirty pupils and action taken
Pupils slouching over desks, sitting back on two legs of chair, leaning against radiators
Dealing with interruptions
Type and value of homework set.

Gradings are normally made on a five-point scale:

A. Exceptional: between 5 and 10 per cent of teachers: outstanding people who will make their mark in any technical college and under any circumstances.

B. Very Good: about 20 per cent: will do an efficient job irrespective of quality of teaching environment.

C. Average: The large proportion in this category: in most circumstances will do a reliable, steady, unexciting job of work without much originality.

D. Below Average: marked weaknesses, need sympathetic guidance for first years in teaching.

E. Fail: completely ineffective.

APPENDIX I

Huddersfield College of Education (Technical)—Confidential Reference

Student's Name ....

1. *Subjects Student can Teach* .... *Remarks* ....

	Subject Level (in relation to F. E. Courses)	Knowledge of subject: capacity to relate it to vocational needs: level of interest: strength/weakness.
(i)		
(ii)		
(iii)		
(iv)		
(v)		

2. *Ability to*:

(i) use blackboard effectively ....

(ii) use other visual aids (film strip etc.) ....

(iii) demonstrate effectively ....

(iv) make simple illustration models ....

(v) evolve illustration experiments ....

3. *Classroom Speech*

(i) Vocabulary

(ii) Grammar

(iii) Delivery

(iv) Interest value

(v) Ability to co-ordinate speech with illustration devices

(vi) Weaknesses, if any

(vii) Outstanding qualities of any kind

4. *Class Activity*

Use of class questioning

Use of class discussion

Use of informal technique

Capacity to obtain active response from class

5. *Class Organisation and Management*

6. *Preparation of Lesson Material*

(i) Collection, selection of material for the appropriate level, class, students, course

22. *Whether recommend*

(*a*) with hesitation, and why ....

....

....

(*b*) with confidence ....

....

....

(*c*) without reservation ....

....

....

Report of Working Group A(4)—Supply and Preparation of Teachers and Ancillary Staff

Chairman: Mr. B. P. Kiwanuka (Uganda)

Introduction

1 In addition to discussing this topic in general, the Working Group was asked to comment in particular on a paper prepared by the Secretariat outlining draft suggestions for a Commonwealth Technical Teachers Training Plan. This paper was prepared as a result of a suggestion made by the Committee on Technical Education of the Third Commonwealth Education Conference held in Ottawa in 1964.

2 The Group has reported separately on its discussions of this paper, and its suggestions have been communicated to the Chairman of the Commonwealth Education Liaison Committee.

3 It is clear from reports and discussions how much progress has been made in technical teacher training in the Commonwealth and how much more is planned. But it is also clear that there are many problems which are either unresolved or to which present answers are inadequate or only partially successful. It would be remarkable if this were not so. Technical teacher training even in developed countries is not yet twenty years old and in the developing countries it is even newer. A number of observations follow:

(*a*) Many of the problems of technical teaching and of technical teacher training are peculiar to themselves. They are not the same as in general teacher training and they are not necessarily the same in developing countries as in the developed countries. There are, therefore, dangers in absorbing too much of the existing patterns of training or in elevating experience into a body of principles transferable to different objectives or different conditions.

(*b*) Both the magnitude and the urgency of the job to be done cannot be over-stressed, especially in the case of the developing countries. Time is not on our side.

(*c*) It may be necessary, therefore, to jettison some of the built-in approaches and concepts and to re-examine every aspect of technical teacher training—objectives, organisation, content, methods—to meet different and varied needs and to take account of the size and urgency of the job. Is it better to train three teachers for one term or six teachers for six weeks rather than one teacher for a year? If so, how could such courses—or any others—best be organised? What should be their content and methods? Where could they most effectively, most quickly, most economically be done? It is clear that some demonstration and teaching equipment is lying around unused because of the teachers' lack of confidence or know-how or because it is the wrong equipment anyway. If it is lack of know-how, how can the teacher quickly be enabled to use it effectively? If it is unsuitable, what is the right equipment? There are obvious long-term advantages in "training the trainers". This is a clear priority if countries are to establish their own systems of technical teacher training as soon as possible. Where and how can this best be done, bearing in mind that the established pattern of technical teacher training is not necessarily the best? How can the problem of providing accelerated industrial training and experience best be met? This is a crucial problem in countries with limited industrial development. All these questions need answering for each level of technical teacher education and training—craftsman, technician, etc. In the end, they are not general problems of how to organise technical teacher training in a flexible way. They are specific problems of how to train teachers of this or that particular craft in country A, or of this or that type of technician in country B. The needs may well be known. The methods best suited to the particular problem will require much more investigation, experiment and research.

Technical Teacher Training

General Comments

4 The essential requirements are readily definable:

(*a*) Adequate subject knowledge and skill.

(*b*) Experience of its application in industry and commerce.

(*c*) Ability to teach particular subjects at particular levels. This implies understanding of students and how they learn and of the appropriate teaching techniques. There are common basic elements in teacher training but the interpretation and applications of these to industrial and commercial situations are different.

5 Just as in the discussions on technician training there has been emphasis on the need for job analysis as the starting point, so the first requirement in technical teacher training is to make a job analysis of what a technical teacher is required to do in a developing country and how he can be educated and trained to do it in his own environment. Similarly, an analysis of the kind of person needed would be useful.

General education and technical education background

6 (*a*) However desirable minimum academic standards may be, it may not be possible to insist on these as a pre-requisite for training, especially in developing countries, if the demand for teachers is to be met at all.

(*b*) The problem might be met by providing intensive courses of limited duration to meet particular deficiencies, e.g. in basic mathematics and science as might be needed when skilled craftsmen are taken into teaching from the shop floor.

(*c*) Further theoretical study could be undertaken and higher academic qualifications obtained after entering teaching through in-service courses.

Industrial experience

7 (*a*) Technical teachers, whether at craft or technician level, need experience *at the level at which they are teaching* and of a quality which is respected by their students. Only in this way can they give their teaching the necessary

vocational relevance and have a proper appreciation of their students' role in industry.

(*b*) Relevant industrial experience is in many cases the most difficult thing for the developing countries to provide for their technical teachers—more difficult than the theoretical knowlege or the pedagogical training. *We would, therefore, urge most strongly that one of the most useful contributions the industrialised countries can make is the provision of facilities for industrial training backed up by the liberal provision of scholarships and fellowships for this purpose.*

(*c*) More industrial training and experience could and should be provided on an accelerated basis by carefully planned schedules as is done in sandwich courses and with graduate apprentices.

Structure of Technical Teacher Training

8 (*a*) The training of technical teachers can be done within different organisational patterns, e.g. in a separate purpose-built institution as at Huddersfield or in association with another institution:

- (i) by establishing separate technical teacher training colleges;
- (ii) by having a technical teacher training wing attached to general training colleges;
- (iii) by attaching technical teacher training departments to polytechnics.

The choice may be determined by particular circumstances but it is important that whatever structures are used should:

- (i) allow the best deployment of available resources of staff, buildings and equipment;
- (ii) make it possible for the technical teacher training to be done in close association with technical schools and colleges and with industry;
- (iii) allow for the free exchange of ideas and avoid the danger of perpetuating training at its lowest level.

(*b*) *Regional Colleges*—Consideration was given to the desirability and practicability of developing *regional* centres for technical teacher education and training. These would be in centres where there could be close contact with technical institutions and with industry. They would be colleges providing technical teacher training for teachers from a large region or from a number of countries in a region. They could meet a real need while training facilities are being developed in the separate countries.

(*c*) Provision should be made for short courses of both initial and refresher types as well as for a long-term programme of technical teacher training. These are considered in more detail later.

The Exchange and Supply of Resource Personnel and Teachers and the Supply of Equipment for establishing Technical Teacher Training Institutions

9 (*a*) Discussion of this quickly led to the need to determine the basic philosophy and objectives of technical teacher training in a developing country. These may be summarised as follows:

> A technical teacher teaches specific things to specific students for specific reasons, and the level of his teaching is determined by his qualifications, subject

knowledge and skill. An analysis should then be made of the work of the teacher at the particular level, including the underlying scientific principles, mathematics, etc. The teacher should then have at his finger tips the large body of experiments, demonstrations, aids to learning, tests, etc., to illustrate these. The aim of training and the design of training should be to make him effective over the first few years by giving him all that is necessary to do his job as outlined above.

(*b*) There is a need for a group of people experienced and involved in technical teaching and training to draw up memoranda of guidance on all aspects of aids, equipment, etc., and staffing needed for technical teacher training. These could then be made available to recipient countries to accept, reject, or adapt to their needs. To avoid duplication of existing facilities, information should be available about equipment available in technical colleges, universities, industry and commerce in the recipient countries.

The Supply of Consultants and Teachers to help in conducting Short-term Courses or Refresher Courses

10 (*a*) The term "short courses" is interpreted as courses of not more than about six weeks in length. They would most commonly be for in-service teachers but short, intensive pre-service courses for basic technical teacher training could make an important contribution.

(*b*) There is scope for many types of courses concerned with all areas of teacher training, e.g.

(i) subject-matter—for extension, for bringing teachers up to date in their subject or technology.
(ii) industrial training—for accelerated courses, for introducing teachers to new industrial processes and techniques.
(iii) teaching method—for basic training, for the methods of teaching a particular subject or for particular techniques (e.g. teaching aids).

(*c*) There could be considerable benefit in providing courses for senior education staff, e.g.

(i) One-week conferences for Principals, Heads of Department, Headmasters to meet for discussion.
(ii) Training courses for senior staff with organisational and administrative responsibilities.

(*d*) It is vital to accept the need for the constant re-education and re-training of technical teachers. Teacher education and training cannot be "once for all". If technical education is to do its job effectively, there must be provision—and encouragement—for staff to keep abreast of developments in teaching method, and of developments in industry and commerce. The most effective means of doing this is by the provision of in-service courses and seminars.

Systems of Education and Training Awards

11 There is a need to reappraise the existing systems to ensure maximum effectiveness and flexibility. Recruitment is adversely affected in some cases by too high a level of technical qualifications being required and by recipient countries having to pay passage fares, although it is realised that the payment of passage fares by recipient countries in practice makes possible an increased number of awards by the donor countries. The degree of flexibility which such schemes allow is not always fully appreciated and it would be helpful if this could be indicated in the terms of awards. The schemes provide for technical education, industrial experience, and teacher training and it is most important that countries sending Commonwealth students should give a precise statement of what is required for each student. The course can then be planned to this end. The teacher training course could be varied in length and content to suit a particular applicant for an award. Flexibility of training could be defeated by insistence on the gaining of a formal qualification. A separate scheme for technical teachers is not considered desirable but we recommend an increase in the number of awards for technical teacher training as an addition to the total number of awards. However, priorities in the allocation of available awards should be a matter for the recipient countries to decide. The allocation of awards should take into account the overall importance of training the trainers of technical teachers.

Discussion of Report in Plenary Session

The draft suggestions for a Commonwealth Technical Teachers Training Plan prepared by the Secretariat, and the comments of the Working Group on these suggestions, were discussed and the opinions expressed noted. A separate report of this discussion will be made to the Chairman of the Commonwealth Education Liaison Committee.

Attention was drawn to the considerable potential value of the development of informal links between technical colleges and other institutions in the developed countries on the one hand and in the developing countries on the other. Such links should facilitate recruitment and make possible an exchange of staff at various levels.

Concern was expressed at the problem of wastage. This often results from the fact that trained technical teachers have more opportunity than other teachers of finding better-paid employment in industry. There is no final solution to this problem, nor should there be, as industrial experience is a necessary and recommended qualification if a technical teacher is to advance in his career. A proper balance is required, however, and this cannot be achieved unless the teacher of technicians is accorded a proper status and appropriate remuneration. The actual remuneration offered need not necessarily rival that obtainable in industry, but the intending teacher should be offered a career framework which he understands and which will attract him. An effort should be made to establish the facts concerning wastage by finding out what has happened to technical teachers who have been trained under schemes of co-operation.

It was stressed that a practical approach should be adopted towards the problems of training students sent overseas. Countries sending students should indicate with some precision the kind of training needed so that receiving institutions may be in a position to provide courses to meet particular stated needs.

CHAPTER VIII

Entrance Requirements and Selection for Technician Education and Training and the Evaluation and Recognition of Standards of Attainment

Lead paper presented by Dr. J. T. Young, Principal, Chance Technical College, Warley, England.

Introduction

1 It has been said[1]* that 'the general aim of technical and vocational education is to provide instruction and further education to men and women of all walks of life, which is suited not only to their abilities but also to the needs of industry, commerce, Government and the community at large.' The subjects of the present paper must therefore be viewed against the broad background of industrial and social need, and, before attempting to set out specific requirements, the purposes and objectives of entry conditions and selection mechanisms must be examined and a general philosophy towards technicians established. In turn, this must begin with a review of the needs of technicians so far as education and training are concerned, for only when these are recognised can a definition of the kind of entrance requirements and system of selection necessary to satisfy those needs be identified.

The Needs of Technicians

2 In the present Conference, no specific definition of a 'technician' has been attempted, although in a background paper the term is broadly explained. In this the word 'technician' covers no less than the whole stratum between the craftsman and the technologist and embraces not only a wide range of expertise but a wide variation of subject interest. In such circumstances it may appear difficult if not fruitless to attempt to isolate features which are common to all or most technicians. Yet, if a multiplicity of treatments with a consequent variation of standards is to be avoided, this must be done.

3 Clearly, one characteristic must be possessed by any technician from his very name—he must be familiar with certain techniques, and this characteristic provides a good point from which to start. These techniques may be specific to one industry, branch of industry, factory or service, or they may be useful throughout a group of occupations. For example, a technician in the foundry industry will be concerned with much that is peculiar to this industry alone whereas most of a laboratory technician's work is applicable in a wide variety of situations. In whichever of these two groups his particular techniques fall, however (and most technicians will need to know some of each), they will need to be directly related to his employment. Employment thus conditions the form and scope of the education and training the technician must receive.

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* *Note:* References are listed at the end of this paper.

4 Such a link between occupation and training, although inherent in all vocational studies, is most close in the field of technician instruction so that the entrance requirements which need to be formulated and the selection mechanism which needs to be imposed, must likewise be related to the ultimate employments in which the entrants are to be engaged.

5 This does not mean that the schemes of instruction to which selection leads are thereby restrictive, and so divorced from broad issues that they are undemanding and of little educational value in the wider sense. The reverse is true and any programme of education and training for technicians which is too elementary in character or too narrowly vocational in outlook and content, will not only fail to produce cultured men and women, it will not produce competent technicians either. This is clear when the origins of technician employment are considered. The technician has arisen in society as the direct consequence of the growing complexity of modern industry and commerce, itself the result of the inexhaustible fertility of human invention. In addition, under the insistent pressure of a need to improve and through the stimulus of scientific research and development all industrial and commercial techniques are ephemeral. As new industries rise, as old methods are outstripped by others more efficient and less costly, techniques change and demands are made for new skills and altered expertise. In such an environment, one who lacks either the basic intellectual equipment to absorb new ideas readily, or whose training has been narrowly oriented in too specific a direction will be found inadequate. The needs of the technician, therefore, are very different from those of the manual worker however skilled the latter may be, and his attainments will be of a different order from those associated with the traditional crafts. These needs can be expressed through certain broad criteria, applicable over the whole range of technician employment, and are as follows:

(i) A technician must have an appropriate mastery of those techniques which are directly utilised in his immediate employment;

(ii) A technician must possess a knowledge of basic mathematics and science sufficient not only for the intelligent application of his particular techniques, but also to permit of later extension and re-specialisation as this becomes necessary;

(iii) Since he may be called upon to control and direct the work of those at a lower or different level of skill, he must know something of the nature and problems associated with these skills, and must himself have gained a varied workshop, laboratory or commercial experience;

(iv) He must be able to communicate with his colleagues, whether he be responsible to or for them, and must understand both his own and their significance in the work-situation in which they are all employed.

6 Such an analysis makes it possible to visualise the standards which must be demanded of those who aspire to become technicians, although, since the technician function covers a wide range of employments, a variety of routes will be necessary leading to a range of qualifications. The standards set however, must be the same (for corresponding types of instruction) whatever the nature of the educational system through which they are attained. For, while it is for each community to interpret the requirements of its own industries, agriculture

and commerce in its own particular way, the personnel it trains will be measured against the tasks they have to undertake and not against the system which produces them.

Entrance to technician education

7 The requirements governing entrance to courses of education and training for technicians should be such as to ensure that the students admitted to them are capable of profiting by and succeeding in them. The requirements, therefore, must be directly related to the content and objectives of the courses and not be set at so low an academic level that the courses have a high wastage rate. On the other hand, neither must the conditions be so rigorous that deserving candidates are excluded while at the same time valuable manpower is deflected from more advanced courses. The object must always be to place each student on the course best suited to his personal qualities and abilities taking into account his own inclinations and ambitions and the needs of the community at large.*

8 One other proviso must be added—there will always be some whose potentialities are discovered belatedly, or whose interests and objectives change. Routes must therefore be kept open so that such people may have the chance to change direction, or, having followed one course of study to the end, advance further with another.

9 The form of the actual entrance requirements, while differing in detail according to the nature of particular occupations must present a common standard. It is usually found necessary also for provision to be made for two broad types of technician course:—

(*a*) for those in whose work practical knowledge and ability is foremost, i.e. where the training needs to have a substantial craft content;

(*b*) for those in whose work there is greater emphasis on theoretical knowledge i.e. where the training needs to approach more to a professional standard and outlook.

10 A distinction should be drawn between this difference in objective and the division of training into 'stages' or 'levels'. Any course of instruction may have 'higher' and 'lower' stages but (*a*) and (*b*) above are different in kind. (The existence of these two groups can readily be distinguished by a study of systems already in operation in various countries and references are listed at the end of this paper[2].)

11 Whatever the detailed arrangements, however, it is essential that the courses of instruction and hence their entrance requirements be designed solely for technicians. The great failing of the original British National Certificate Scheme was that, although it offered a most valuable 'second route' to professional status, it attracted many who were unfitted to its methods or objectives. Being used simultaneously for two opposed purposes, it ended by satisfying neither. In addition, the association of National Certificates with the professions conferred upon them a kind of reflected glory which diminished the status of other valuable courses and made them less attractive[3]. It also had an effect on the academic levels of the courses of study themselves so that, over the years,

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* Examples of a Course Entrance Examination and a Training School Perception Test are given in Appendices A and B of this paper.

National Certificates tended to become more and more allied to professional standards and more and more unsuitable for technicians. This kind of movement seems to be a tendency of all educational systems and it is of particular importance for the training of technicians that it be resisted.

12 'Educators of technicians are subjected to severe sociological pressures gradually to raise the standards of their courses. The gradual elevation of course standards, as an expression of an aspiration to professional status, via sub-professional education, is not possible while such education is conducted to fulfil its proper function, that is, the production of technicians.'[4]

13 If technicians are to be produced in the number and of the quality demanded by modern industrial communities, then they must be seen as essential in their own right. The technician must never be regarded as inferior, as one who perhaps has aspired to, but could not reach, professional status. He is, and must be seen to be, as important as (and often more important then) a technologist. One way of bringing this about is to set up courses especially designed for technicians, entrance to which is guarded by carefully-planned conditions.

14 With these various factors in mind, entry requirements to technician courses may be framed as follows:

Direct Entry

(i) *From School*

(*a*) Holders of a General Certificate of Education at the Ordinary Level including as a minimum passes in Mathematics, a Science subject and satisfactory command of the English Language

(*b*) Holders of other qualifications judged as of a standard equivalent to (*a*), for example, the Certificate of Secondary Education (Britain)[5], The West African School Certificate, the Royal Society of Arts School Certificate, The subject requirements should be the same as set out in (*a*) and the level of pass of comparable standard.

(ii) *Through other qualifications*

(*a*) Holders of a craft certificate equivalent at least to the standard of the Intermediate or Part I of a Craft qualification of the City and Guilds of London Institute.

(*b*) Candidates who wish to transfer after one or two year's study on a degree or professional course should be enabled to do so by the granting of suitable exemptions.

Indirect Entry

Where too few candidates come forward from among those leaving school, or where the secondary-school system is insufficiently developed, pre-technician courses will be necessary through which entry can be made. These should aim at a standard not dissimilar to that set out in (i)(*a*) and (i)(*b*) above, both in level and subject content.

Sources of technicians

15 The range covered by the terms Intermediate Level or Technician Level manpower is wide both as regards intellectual demand and subject interest and in the past this manpower has been recruited from a variety of sources and in a variety of ways.

16 Most recruits to technician occupations, however, may be placed in one of three classes:

(*a*) Craftsmen of superior ability who are transferred to technician employment and acquire the necessary additional expertise either by experience on the job or by specific retraining.

(*b*) Technologists or would-be technologists who do not achieve their chosen objectives (either of occupation or qualification) and are utilised in a technician occupation.

(*c*) Those who aim to be technicians from the outset and whose education and training are directed specifically to this end.

17 In the past, many have belonged to class (*a*) whilst lack of appreciation of the true value and purpose of advanced education has led to the employment of numbers of highly-trained technologists in situations demanding much less than their total ability. These sources, however, are limited and although they will undoubtedly continue to be used for some time to come, future recruitment must look increasingly for those who fall into class (*c*). It is to these that courses of instruction, entrance, requirements, selection procedures and examination standards for technicians must principally relate.

Selecting technicians

18 In a situation in which there is an ever-increasing demand for trained manpower it is perhaps better to think of 'placing' technicians rather than 'selecting' them. For the real task is to place each trainee on the course of instruction, and in the occupation, for which he is best fitted rather than merely to exclude the unsuitable. Although the demand for places may exceed the supply so that only a limited number of candidates can be accepted, the concept of 'placements' is none-the-less valuable since it emphasises that all trained manpower is vital to the life of a community, at whatever level it may operate.

19 Where entry requirements to courses of study are expressed in terms of examination achievements, these act as the instrument of placement, although some further, more personal check may be thought advisable. This is particularly important where admission to a full-time, sandwich or block-release course is being sought. Courses of these kinds demand attributes of character and temperament which are not usually revealed by a bare recitation of examination successes.

20 It is for those who seek to enter a course for which no evidence of specific educational attainment is asked (e.g. a pre-technician course) however, that some form of selection procedure is most needed. Not only are the customary yard-sticks missing in such cases but it is to this group that the future recruitment of technicians increasingly must look.

21 Such trainees may enter directly from school or they may first be recruited by industry or commerce to enter the firm's own training scheme and be granted release from employment for part or full-time instruction in an educational institution. Progressive firms usually have selection procedures which govern

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entry to their own schemes and some colleges have developed arrangements for the correct placement of new students. Nothing like as much has been done in this field, however, as the situation demands and there is a great need for investigation and research both on the part of public education systems and of private industry.

22 The problem is, of course, associated with that of vocational guidance, and while this is a matter more for the schools than for further education, it is relevant to refer to it here. Certain countries have developed the service of vocational guidance to a greater extent than others and France and the United States of America are often quoted in this connection. The Youth Employment Service in Britain also fulfils a most useful role in assisting young people to choose suitable occupations. Relating interest and ambition with capability, however, is a difficult and thankless task and all too often the counsellor is confronted with aspirations which far exceed the intellectual potential of the aspirant. A systematic, public, vocational guidance service would do much to overcome this particular difficulty.[6]

23 Close liaison between individual colleges and local industry is a most valuable aid to careful placement. This is so for both full-time and part-time students and it should take the form not only of joint action at the time of enrolment and selection but throughout the course of instruction by discussions, visits and even interchange of staff. In this technical education and industrial training are seen to have a common aim.

Pre-technician courses

24 A pre-technician course is one which has been especially designed for boys and girls who are judged as potentially capable of satisfactorily completing a technician course but who lack the necessary entrance qualifications. Depending upon the level of the technician course for which preparation is made, a pre-technician course may follow normal secondary schooling or it may run parallel to it for one or more years. Such a course (which is usually of two years' duration although some candidates may be required only to complete a one-year course) constitutes a valuable ancillary means of recruiting suitable candidates for technician employment. It also has the subsidiary function of acting as a diagnostic agent in that success or failure on a pre-technician course is a measure of a student's prospects on a technician course itself.

25 The concept is perhaps best exemplified by the system of General Courses developed in the United Kingdom following the 1961 White Paper 'Better Opportunities in Technical Education'.[7] These courses have been described in the White Paper and elsewhere and for details reference should be made to suitable sources. As the system has now been operative in Britain for five years, however, some conclusions drawn from experience with its actual working may be of interest.

(i) It is essential that entrants to a pre-technician course be carefully screened. Attempts to use the course itself as an instrument of selection by admitting everyone who applies, leads only to a very low pass rate in the examinations at the end of the course or to a lowering of standards.

(ii) A careful watch must be kept on the academic level of the course. There is a tendency for the standard of an examination to reflect the performance of the average examinee so that, if the quality of the latter rises (say, through better selection), the standard expected of a successful candidate rises as well, so preserving the overall pass rate. This defeats the object of any placement procedure and frustrates the prospect of increasing recruitment to technician courses.

(iii) Students who successfully complete a pre-technician course frequently do better on the technician courses which follow than those who enter directly from school by virtue of suitable examination successes. School curricula are often over-academic in nature and consciously designed primarily for those who are aiming at the professions or the university. A pre-technician course which includes English language, mathematics, science, technical drawing and one or more workshop subjects is not only a better preparation for a technician course for many students but often calls forth better efforts from them.

(iv) A pre-technician course may be offered either on a part-time or full-time basis. It is to be viewed as 'further' education rather than belonging to the school system. It thus offers possibilities of teaching methods and liaison with industry which would be inappropriate to secondary schooling.

Technician Courses and School Curricula

26 Vocational education and training is dependent upon the general education which precedes it. In turn, this general education cannot remain unaffected by the characteristics of the further studies to which it leads. Education, however, is much more than formal schooling alone and all young people are conditioned by the environment in which they live and the example of those in whose care they reside. An industrialised society enables boys and girls to become acquainted from their earliest years with the products of modern technology while the basic concepts of mechanics, electricity, light, sound and the properties of matter are there to be absorbed without conscious effort through daily contact with bicycles, railway trains, aircraft, radio, television, household machinery and the like. For such young people the transition from informal observation to formal instruction in mathematics, science and technology is much assisted by this common experience.

27 An undeveloped or predominantly agricultural society of a traditional type will present its youth with a very different background of experience and in such societies a much greater burden is laid on the educational system, in particular on the secondary schools. Here there are two false views; first, that technical subjects and methods of instruction are narrow and undignified and hence not to be introduced into school curricula; second, where such instruction is provided, that it is appropriate for it to be the same kind of instruction that would be given to craft apprentices.

28 These dangers can be averted by the development of practical work designed to develop manual and artistic dexterity and to encourage self-expression. The main purpose of secondary education, of course, must always be to continue the general education begun in the primary schools. Nevertheless, for those who may ultimately become technicians, contact with science, commerce and technology cannot be left until secondary schooling is over, and this is particularly necessary where the community-at-large provides few practical illustrations of the use of these studies. Subjects such as woodwork, metalwork, art, technical drawing, general science, domestic arts and commerce afford good opportunities of providing this essential experience if they are given a liberal presentation. There must be no attempts at premature specialisation however, for those whose minds are yet plastic and whose futures are yet to be decided.

Examination arrangements

29 In the United Kingdom, examinations for those who have studied on courses at technician level are controlled by two main agencies—for National Certificates, by Joint Committees especially set up for the purpose, and for other courses, by the City and Guilds of London Institute. The former system, which depends on the examinations being conducted either by individual colleges or by Regional Examining Unions formed by Local Education Authorities (with external assessment in each case), can only operate where there is a well-established structure for further education and is not truly exportable. Countries which have chosen to follow the British pattern of technical education, therefore, have used the overseas service of the City and Guilds.

30 Originally, many of those taking the Institute's examinations were expatriates but with the growth of industrial economies and the spread of self-government, Commonwealth countries began to establish their own systems of technical education and examination and these were often based on City and Guilds' procedures. This is an inevitable development because examinations and courses designed primarily for the United Kingdom seldom meet the exact needs of other countries without modification. The subject content of the examination questions for instance, may not be relevant to local conditions and attempts to overcome this by widening the scope of the examinations lead either to a mulitplicity of separate papers or to the setting of many questions on single papers, neither of which is really desirable. There is also the obvious problem of finding enough trained and experienced persons to control and handle the actual examinations.

31 The general policy adopted by the Institute to meet these difficulties has been to continue to offer examinations, linked where possible to existing courses of study where these were offered at reputable institutions under responsible jurisdiction; to cater for special, regional needs by modifying particular syllabuses; and to create new syllabuses and examinations where there is no United Kingdom counterpart.

32 It is recognised, however, that in the long run self-government must be the objective, with each country regulating its own educational standards. At the same time it is essential that these standards retain international validity and it is here that the City and Guilds of London Institute, through its Committee for Work Overseas, can continue to offer assistance.

33 In brief, there are four stages through which progress to autonomy in examinations should pass:

(a) syllabuses to meet specific local needs are prepared either by using those of the Institute or those of the Institute modified;

(b) examiners to set and mark the papers are trained;

(c) purely 'local' syllabuses are drawn up and the examinations on these are set and marked locally with the Institute acting as assessor, associating itself with the certificates awarded;

(*d*) complete independence is achieved, the Institute merely providing professional advice when this is asked for.

34 Such a programme can be introduced subject by subject so that, as an economy grows and develops, there is progressive transfer of responsibility with continued maintenance of standards.

The status of the technician

35 In the final analysis, no matter what entrance conditions are imposed, no matter how carefully the entrants are selected, no matter at what level the examinations are set, all will depend on the value which the community-at-large attaches to the purpose of these arrangements. Unless the role of technician in the society is seen clearly and his importance given public recognition in both status and salary, the candidates coming forward will always be insufficient in number and in quality.

36 The problem of educating and training technicians, therefore, is fundamentally a social problem, not one merely of educational method. Entrance requirements and selection procedures will contribute towards producing better-trained men and women but the real solution lies only in the attitudes and beliefs of society as a whole.

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APPENDIX A

Chance Technical College
Department of Building
Construction Courses Entrance Examination

Attempt as many questions as you can.

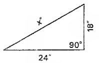
Time allowed 60 minutes.

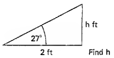
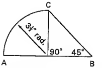
Use the tables provided as necessary.

Answers and working to be written on the question papers. If necessary, the backs of the sheets may be used for rough working.

Name.. Age.............

No.	Question	Answers	Working
1	21·5 − 2·42 =		
2	2 lb. 8 oz. in ounces =		
3	1 ft. 8 in. + 9 in. in inches =		
4	2 tons 16 cwt. ÷ 8 =		
5	$1\frac{3}{4} + 2\frac{1}{3}$ =		
6	$7\frac{3}{8} - 3\frac{1}{6}$ =		
7	$\frac{7}{8}$ of £43 =		
8	In 12 minutes a motor car moving at 45 m.p.h. will travel =		
9	If $1\frac{3}{4}$ lb. costs 1s. 2d., then 14 lb. will cost =		
10	$5\frac{1}{3} \times 2\frac{1}{4}$ =		
11	$1\frac{7}{8} - 1\frac{1}{4}$ =		
12	20 per cent of £3 =		
13	If x = 7 and y = 3, then xy − x =		

No.	Question	Answers	Working
14	If $d + e = 7$ and $e = 2\frac{1}{2}$, then d =		
15	If $a = 3$ and $b = 4$, then $a(3a - b)$ =		
16	If $a = 53 + b^2$ and $b = 4$, then a =		
17	If $2x + 3 = 9$, then x =		
18	The area of a circle of radius 2 inches =		
19	The area of a rectangle 5 yds. long and 3 yds. wide =		
20	Two of the angles of a triangle are 20° and 70°. The third angle =		
21	The cost of fencing a square garden at 4s. 3d. per yd. is £11 6s. 8d. LENGTH OF ONE SIDE =		
22	Volume of water in a tank 3 ft. long, $1\frac{1}{2}$ ft. wide, 2 ft. deep =		
23	Find x  		
24	Simplify $3(2x + 5) - 2(x - 1)$		
25	Find x if $3(2x + 5) = 24$		
26	Using logarithms evaluate: (i) $356{\cdot}3 \times 18{\cdot}59$		
27	(ii) $16{\cdot}54 \div 6{\cdot}543$		

No.	Question	Answers	Working
28	Evaluate $2p^2 - pq$ if $p = 3$ and $q = -2$		
29	Find x and y if $\left.\begin{aligned}2x + y &= 11\\ x - y &= 1\end{aligned}\right\}$		
30	Factorize (i) $16x^2 - 9$		
31	(ii) $5a^2b + 15\,ab$		
32			
33	If $v = u + ft$ rearrange to give a formula for t		
34	 Calculate area of template ABC shown		

APPENDIX B

Training School
Perception Test

On the attached drawing 'Q1', each row of sketches shows four views of an object and one view of an object slightly different in shape. Find this one object and name it by the numerical and alphabetical references at top and left-hand side.

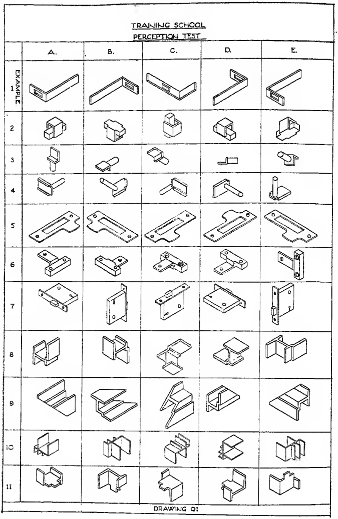
Example: In the top row, '1C' differs from remainder in same row.

For examiner's use

1	C	7	B
2	D	8	C
3	E	9	D
4	B	10	E
5	E	11	A
6	A	Marks	
		Time	6 mins.

Name..

Date..



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Report of Working Group A(5)—Entrance Requirements, Selection, Standards of Attainment

Chairman: Mr. D. J. Williams (Nigeria)

Introduction

1 The Group accepted the general definition of the technician which places him between the craftsman and the technologist and having a suitable selection of the following qualities:

(*a*) a mastery of techniques;

(*b*) a knowledge of subjects relevant to future job needs, e.g. mathematics, science, languages;

(*c*) sufficient knowledge of processes in workshops, laboratories and offices to operate, direct and control;

(*d*) the ability to analyse problems arising from his work, and to apply knowledge and principles to their solution;

(*e*) an ability to communicate.

2 An examination of many of the papers submitted at the Conference, and especially Table VII of the paper presented by Mr. J. C. Jones*, revealed a remarkable measure of agreement upon the minimum entrance requirements which would enable technicians to follow appropriate courses. In spite of the number of countries involved and the variety of courses envisaged, it appears that potential technicians everywhere are required to complete successfully, in all, some eleven years of school education, usually six or seven years primary, and four or five years secondary (or where 'intermediate' schools exist, an equivalent period) culminating in two or more O-level passes, including mathematics and an appropriate science or commercial subject. It was noted that technician course entrance requirements are having an effect upon school curricula. An increased emphasis upon science and practical and vocational subjects is evident in secondary schools.

Selection for Technician Courses

(a) *Problems of Selection*

3 Problems arise (i) when there is an excess of applicants possessing the minimum qualifications; (ii) when the insufficient development of secondary schools causes a shortage of adequately qualified applicants; and (iii) when it is desired to transfer craftsmen, lacking secondary school education, to the technician grade. In cases (ii) and (iii) carefully designed 'bridging courses' may be used to meet specifically local needs. Difficult problems for colleges can arise where students, already accepted by industry and commerce, have to be absorbed. Experience shows that co-operation between college authorities and industry and commerce produces the most effective choice of technician student.

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* See Chapter XI.

4 The Group accepted that there are two main bases for selection procedure. Firstly, a student should be placed into the level and type of technician course in which he is most likely to succeed; and secondly he should be guided into the type of job where his abilities and interests are most suited. The instruments at present in use for placing students—i.e. interview, 'entrance' tests, objective tests, psychological tests—are sometimes crude and unvalidated. In order to keep wastage to a minimum, the development and publication of refined placement techniques is essential.

(b) *Wastage*

5 In the past, selection procedures have failed to avoid serious wastage. It is felt, however, that wastage should not be regarded as synonymous with failure to complete a technician course: there should be adequate avenues for the redeployment of such people into more suitable courses and jobs. It should be noted also that stages in technician courses which represent an intermediate step for some students, may provide a suitable end point for others.

(c) *Recommendations*

6 The following recommendations are made:

(i) that more comprehensive and detailed documentation should be adopted by schools, so that accumulated information on students' previous educational records is available to help in prognosis;

(ii) that career counselling and guidance services should be instituted or expanded, and undertaken only by people professionally competent in this field;

(iii) that there is an urgent need for an intensification of research into the development and validation of placement techniques;

(iv) that a clearing house for information on research on technical education problems should be established, possibly as an adjunct of CELU.*

Evaluation of Technician Education

7 The objectives of assessment at progressive stages of a technician course will change. In any technician course an intermediate examination may assess scientific and technical knowledge and ability; a final examination can give a technical qualification of some merit; whilst a further examination can give a specialist qualification with emphasis on applications. At the same time the assessment must be regarded as a continuous, purposeful process. Both colleges and industry should play their part in the assessment of technicians. It is the function of colleges to assess the academic parts of a technician course, and to test specific skills and techniques in the workshop or laboratory. Industry, agriculture and commerce possess more suitable conditions for the assessment of a technician's performance 'on the job'—testing the ability to apply skills and knowledge effectively in real situations.

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* A recommendation in the Report of the Third Commonwealth Education Conference, Ottawa, 1964 on the subject of Guidance, Counselling, Evaluation and Testing states that the Commonwealth Education Liaison Unit 'could with advantage play a more positive role in establishing contacts between countries which might need or provide help, and in collecting and distributing information'. (Page 7, para. 36.)

Form of examinations

8 Existing examination methods (essays, objective tests, workshop and laboratory tests, etc.) are often narrow and not entirely appropriate to the assessment of technician abilities. Considerable weight should be given to evaluation techniques involving observation of a student's performance when confronted with an assignment or project typical of the kind of problem which he might meet in his employment. The project should be designed to test how well the student has assimilated his academic and industrial or commercial training, and how effectively he can bring these to bear upon the assignment. The abilities and skills assessed must be appropriate to the particular field in which the technician works. These conditions are likely to obtain when there is close consultation with industries, at local and national level. There is already a small number of precedents to follow in this field of examinations, and it is clear from these that careful thought and planning must be given to the criteria and methods of evaluation. It should not be assumed that even the best assessment procedure can give results more precise than that represented by the usual five-point scale.

Assessment of Personal Qualities

9 There was considerable discussion of whether the personal qualities of technicians should be assessed and, if so, by whom. The importance of a sense of responsibility, enthusiasm, determination, adaptability, co-operativeness, etc. were recognised as elements in the make-up of effective technicians, and although teachers are often in a position to observe these qualities, assessments must be seen to be given within the limits of the educational environment of the college. Personal qualities relevant to job performance can be assessed only in the real situation. It was nevertheless felt that the opinions of a variety of people would give a more objective assessment.

Certification of Technicians

10 As a general principle, the full technician status should imply satisfactory performance both in the college course and in approved industrial conditions. Part-time and sandwich course students can, in the main, gain this experience before completion of their college course; full-time students may gain this experience after qualification. It may well be that a period of two years should be stipulated as the minimum time in which a reliable assessment of industrial performance can be made. It is in any case a matter for close co-operation between industrial or commercial and educational interests.

Co-operation between education and industry

11 The need for close co-operation and exchange of ideas between education and local industries is emphasised. It is considered that:—

(i) there is a need for consultations at the selection stage of technician courses;

(ii) there should be more exchange between industry and colleges of personnel who are involved in the training of technicians;

(iii) industry should be encouraged to make use of college records, in order to provide effective job training;

(iv) college facilities should be made available to industry for trade tests and advanced projects;

(v) the co-operation of industry is essential in the planning of effective job experience for sandwich course students, and for full-time students during college vacations, as well as for other education-based courses which demand industrial experience;

(vi) it is important that advisory bodies should be formed for all industries so as to facilitate the exchange of ideas between college and industries, and provide a means for co-operation in the planning and control of all aspects of technician education.

Role of technician associations

12 The established professional bodies should offer guidance and assistance in the formation of technician associations, but whether these are established with the assistance of parent bodies or independently, they can render valuable service in securing proper recognition for technicians. As the same time these associations should not stipulate their membership qualifications in such a manner as to control the nature and content of technician courses.

13 The process of the establishment of suitable courses, and the evaluation of performance, are primarily matters for education and industry, but it is to be hoped that technician associations will co-operate in this field.

Discussion of Report in Plenary Session

There was general agreement that technician courses should be based on appropriate successes in secondary school examinations at about GCE 'O' level or its equivalent but it was recognised that, given the relatively small percentage of an age group which attained that level in school and bearing in mind the competing claims of other forms of education, the equivalent would, in many cases and whatever the stage of development reached by a particular country, take the form of a pre-technician course within the system of technical education.

It was recognised that there would be considerable value in a more uniform system of documentation and presentation of information by secondary schools as an aid to the selection of students straight from school for full-time courses, although it was appreciated that difficulties would continue to arise as a result of variations in the staff and standards of different schools. Considerable emphasis was placed on the need for proper counselling and expert career guidance in secondary schools. This requires specially trained people and should not be left to the ordinary teaching staff. It was noted that some research into this subject is being conducted by the United Kingdom Department of Education and Science.

The selection of students for technical education and for technician courses is part of the wider process of assessment at and selection from secondary education. It should not be considered in isolation and the educational institution must look at the needs of the community as well as at the immediate needs of industry. To a very large extent, the selection of students for part-time technician courses is in the hands of industry, which selects primarily for its own immediate and future requirements. If widely differing standards are to be avoided, and if the wider social needs are to be met, there must be the closest co-operation between industry and the educational institutions: great importance was attached to this collaboration.

There was a widespread view that the present methods of assessment and examination of technicians upon completion of their courses need to be critically re-appraised. If the technician is to be given the status and recognition which he desires and deserves, industry and the public must be convinced of the quality and usefulness of technicians. It was considered that situation assessment, an increased use of project work and similar methods might be more valuable but more research is wanted into the whole question of the validity of assessing and examining procedures. Care must be taken not to reduce the technician's adaptability by directing him too early into narrow and highly specialised fields; industry, in many cases, may prefer a more widely educated technician and reliance on subsequent short periods of specialised training.

CHAPTER IX

Administration, Finance (including Assistance for Students), Control and Inspection

Lead paper presented by Mr. J. W. Gailer, Assistant Adviser on Technical Education, Ministry of Overseas Development, London, England.

The Need for Planning and Consultation

1 Technical education is a complicated and expensive business as is well known and therefore it is necessary to make quite certain that the best use is made of the manpower and finance available. This in turn calls for some form of central policy making and planning, for consultative arrangements among the people and organisations involved and for co-ordination.

2 Central policy making and planning, as has already been said, are necessary if economic and manpower planning are to have any real meaning and these in turn imply consultation and liaison on a continuing basis among a wide group of individuals and organisations. Economists, manpower specialists, educators, industrialists and many more all have a part to play and a point of view. This kind of consultation also permits of the growth of ideas and policies through the interaction of minds coming from different sections of the community and having divergent backgrounds.

3 The need for co-ordination of effort, to ensure that the emphasis lies in the right places, that expensive staffing, equipment and facilities are not allowed to be idle in one place whilst being duplicated in another, also follows from the planned approach and the need to husband scarce resources. Not only must co-ordination be achieved among the institutions themselves but the timing of building programmes and technical teacher development, of feeder arrangements from the schools and of any necessary legislation must also be concerted. Similarly the activities of the Ministries or Departments of Government responsible for labour matters, for economic development and for education must be properly correlated.

4 In the context of the developing country, the need for centralised planning and co-ordination becomes paramount. It is well known for example, that upon achieving self-government, a developing country is besieged by offers of assistance of all kinds. If a central policy on technical education exists or can be formulated before the aid is accepted it should be relatively simple to ensure that the aid is of the right kind, is directed to the important growing points and is thereby maximised. If a national policy is not available then a variety of policies may be imposed from outside, policies which tend to be dictated by the donor, and which, however magnanimous or paternal the latter may be, are often quite unsuited to the needs of a developing economy. Apart from questions of general policy concerning the curriculum and content of technical education, problems may also arise from the provision of training facilities or equipment that are out of all proportion to what the developing country can afford in continuing or future development. Again, difficulties are created when the donor wishes to provide a monotechnic type of institution with which it can so readily be identified, when it is obviously much more desirable, both on grounds of economy in staff and equipment as well as from the point of view of helping to produce an integrated society, to have a polytechnic.

5 Aside from the problems arising from the provision of external aid to a developing country there are others of an indigenous kind which also call for centralised planning, consultation and co-ordination. Two examples should suffice; firstly, the need to control the activities of private institutions without destroying their potential value, and secondly, the need to consider any tendency to over-centralised control by those officials in the Ministry or Department of Government concerned with the development, administration and funding of technical education.

The Division of Responsibility between Government and Industry

6 Clearly the foregoing implies the need for some form of board or council which will permit continuing consultation between the parties concerned with technical education and training. Before looking more closely at the types of arrangement possible however, I would like to explore the division of responsibility between Government and Industry (including commerce) for technical education. The view is often put forward that since industry reaps most of the benefit from the education and training provided, it should be mainly responsible for making the provision and that Government should play little or no part in the business. An impartial examination of this viewpoint shows it to be a dangerous one, particularly in the case of a developing country. In the first place Government's stake in economic development, and therefore in manpower planning, is too great to permit it to leave manpower development entirely in private hands. Secondly, industry's first responsibility, and rightly so, is to make money and therefore its training policies will tend to turn on the fastest and cheapest approach rather than on the broad basic training so necessary from the trainee's and the country's standpoint. In my view a suitable division of responsibility is for Government to provide for the basic technical education at the various levels and for industry to build on this the specialisms it needs. What is needed is a partnership, a co-operative effort, in which the basic and theoretical technical education provided through Government marches hand in hand with the practical training and expertise available through industry.

7 Industry should be able to have a say in the design of the technical education curricula and this is possible through the medium of national or local advisory or executive councils or boards. As we shall see later, industry is usually expected to contribute financially, either through the medium of taxes or directly, to technical education at all levels and therefore has a right to be consulted as to the service it receives from Government-sponsored or aided institutions.

Types of Advisory and Executive Council or Board

8 The simplest method of controlling and administering the technical education system is through direct departmental or ministerial control. It has the merit that many problems can be solved speedily without a lot of red tape and delay, but it suffers from the disadvantages that institutional staff, both academic and non-academic, are at the beck and call of the Ministry staff for duties elsewhere, that curricular and financial matters are at the mercy of a Ministry official who is more often than not an administrator and not a technical education specialist

and that advice from industry may be sacrificed to expediency. In general, institutions in such a system, and their staffs, are subject to all the rules governing a civil service and the operation of Government departments whereas such rules are mostly quite unsuited to the operation of a technical education institution.

9 The next simplest form of administration is to set up one or more executive boards provided with funds, and the right to raise more, and vested with the necessary powers to develop curricula, set up and operate institutions, accredit and examine courses, train teachers and all the paraphernalia of technical education. The Board may be a national one served by a variety of committees, and for large or complex societies, by satellite or regional boards. Alternatively, there may be a national board for each main industry or for a group of related industries, again with attendant committees or satellite boards for specific purposes. Lastly, a national board with attendant committees may be set up to cater for a specific branch or part of technical education (e.g. higher or technological education). In each case the board or boards proper may concern themselves primarily with finance and development, leaving curricula, training and related matters to specialist committees. This would be reflected in the membership, boards tending to be made up of managerial, administrative and academic people, and the committees of professional, middle level and skilled level people having the necessary practical experience and background. There will, in each case, also be a full-time secretariat to carry out the executive functions of the board(s). Whilst the chairman and members need not necessarily serve full-time, they should none-the-less be renumerated and expected to put in a minimum period each month. The secretariat staff on the other hand must be highly qualified and serve on a full-time basis.

10 In a smaller country, or in one in which industry is a relatively small part of the economy, the national executive type of board may well be the most suitable but otherwise all three arrangements have both advantages and disadvantages. The national board, for example, has the virtue that it has all the elements of advice and executive action built in, without bureaucracy. It can also delegate its responsibilities in large countries to regional or area boards. It can readily co-ordinate technical education arrangements. On the other hand, if it works direct to the institutions it controls (rather than through boards of governors or managers) it may well develop all the symptoms of autocracy of which we accused the Ministry.

11 The industrial boards on the other hand have the merit of offering a national approach in a given industrial field and at first sight appear particularly suitable in a complex industrial society. They suffer from two main disadvantages. Firstly, they require a further overall body or organisation to afford co-ordination over the whole field of technical education. Secondly, unless carefully organised and composed they are likely to lead on the one hand to an industry-based rather than a national allegiance, and on the other can lead to a monolithic structure with a lack of correlation between training in the different occupations and professions, leading in turn to loss of flexibility. The industrial boards none-the-less have the overriding virtue that they will attract help and co-operation from industry as no other arrangement would. The third type of board is monolithic by definition and has therefore already lost a degree of

freedom. Here again, there is a difficulty over co-ordination and if the Board were private in fact, there could indeed be duplication from the start with Government institutions.

Boards of Governors

12 A further form of administration is to couple any of the foregoing with indirect control of institutions. This indirect control may vary from complete autonomy in the sense of academic freedom, as granted to a university, through arrangements involving limited autonomy, to a board of managers with virtually no autonomy. The first will only concern us in so far as arrangements have been developed over the last year or so as we have already seen, for the carrying out of technician training under a 'university umbrella". This must inevitably result in certain amendments to the University's charter to ensure that there will be a proper allocation of monies for technician training, that industry has an avenue through which it can criticise the training schemes effectively, and that the staff employed on this work, often non-graduate, will have parity of treatment with other university staff in respect of privileges and conditions of service generally.

13 The more common and the more appropriate arrangement for the governance of a college concerned with technician training is to have the board of governors with limited autonomy. The board is set up under a Government ordinance as a corporate body with an autonomy limited on the one hand by the fact that the college is required to operate courses according to a national or nationally agreed plan or pattern, secondly by the fact that it may have to consult on a national or local basis, before changing salary scales or even student fees. It is also limited financially to the extent that certain Government or board grants are 'tied' to specific projects or payments, whilst a gift may not be accepted which would involve Government or its nominated board in unbudgeted recurrent expenditure. A typical draft constitution and rules for a college coming under indirect Ministry control in the fictitious country of 'Countryland' is appended to this paper. The rules provide for all the foregoing points; in addition they provide for continuity of service of members of the board of governors, for the setting up of committees and a college board of studies, for the appointment and dismissal of staff, for the general financial arrangements and for the appointment of trustees. The rules are drawn up for a college already operating under *direct* Government control which it is proposed shall be put under a board of governors.

14 The last arrangement referred to in paragraph 12 was a board of managers. Here the board cannot appoint staff nor solicit funds nor expend monies and therefore has a rather unedifying supervisory-cum-advisory role. In all these cases it is usual to set up separate industrial advisory committees to assist the boards with technical advice about the needs of local industry.

The Role of Government

15 Whatever the form of administration, there is need in Government, usually, and most advantageously, in the Ministry or Department of Education, for a unit to deal with technical education. It may be a unit which is responsible for the whole of 'further' education, i.e. vocational, technical, university, evening and part-time, or it may be a unit with a role restricted to technical

and vocational education. On the other hand it may be a part of secondary education. In all these cases the unit will have at least two functions—one, the formulation of rules and regulations for the award of grants-in-aid, for the teaching service, for students' scholarships and bursaries, and two, the progressing of estimates and payment of grants. If the Ministry or Department has direct control, then the unit will usually exercise this control and has virtually, together with the Public Service Commission and the Financial Secretary, the functions of the board of governors. Apart from these activities, Government must also provide, with the unit's guidance, legislation affecting apprenticeship (in this case with the Ministry responsible for labour), teachers' superannuation, indemnification of teachers and students from industrial accidents, the setting up of executive, industrial or other boards and of boards of governors, customs exemption for training equipment, and other matters.

Inspection and Accreditation

16 It is perfectly reasonable for a Government or national board to wish to inspect its technical education arrangements in some way to ensure firstly that value is being given for money spent in the shape of grants and secondly, that a sufficiently high standard is being reached, having in mind the national need as evidenced by industrial advice, productivity figures, public or college examination ratings. It is also reasonable for Government or a board or an examining or accrediting body to wish to inspect facilities and teaching before agreeing to recognise or accredit a College for a particular purpose—e.g., the conduct of a technician course in mechanical engineering. This kind of inspection would of course only take place for the given purpose and whilst not being 'antagonistic' would tend to be critical, but there might also be a need for continuing local help of a benevolent and constructive kind, particularly in the larger and more complex communities.

17 One way of meeting these needs would be to attach either to Government or to a national board, a group of specialists which had had appropriate industrial, teaching and administrative experience; they could be under the service of the Ministry or board concerned or ideally they could form an independent cadre of men appointed either on a Cabinet writ in the case of Government or direct by a board and independently of its secretariat. Alternatively, the institutions themselves may set up an accrediting agency on a regional or national level and lay down minimum standards both for general college observance and for particular courses. Better, accreditation may be performed in respect of courses by a professional body. Whichever is the case, the agency will need to call on either its own inspecting service or a suitable ad hoc group, brought together for the purpose.

18 In the case of the smaller countries these arrangements are hardly possible except perhaps in a very general way where a science or engineering inspector of broad experience can act in an administrative and an inspectorial capacity, or where a group of islands, for example, could group together to adopt an accreditation scheme. The alternatives are to invite inspectors from another country known to have a good inspectorate or to link one's institutions with similar ones abroad and utilise the link to test the efficiency of one's teaching arrangements.

The Financial Aspects of Technical Education

19 Let us now turn to the most intractable problem of all in technical education—finance. You all know how costly it is, not only in the sense of the capital required to set up the complex training institutions needed but also in terms of the running costs which seem to spiral forever higher as each year goes by. There is a tendency in many institutions to just let these costs rise without trying to either understand or control them, and in many Ministries, to reduce them in an entirely arbitrary fashion without reference to the real needs. I believe that costs can often be reduced but only if the reduction is based upon a logical analysis of the cost components.

Capital Costs

20 Let us first examine the capital costs. Technical college buildings need to be functionally sound but otherwise architecturally and aesthetically simple. The high costs arise from the complexity of the services, the need for specially strengthened beams, concrete plinths, special channels, special lighting, benches, grouping of laboratories and special circulation arrangements, zoning, multi-storey construction, and many more items, and there is a minimum cost below which one cannot expect the college buildings to fall. Workshops and heavy laboratories can of course be erected using a factory style of construction which would be single-storey and cheaper than the cost of the multi-storey block construction used for the laboratories and classrooms. Circulation space too can be reduced in tropical countries to at least 25 per cent and even less for trade centre workshop construction. Even in multi-storey blocks, a verandah may be adequate instead of a corridor and this keeps down the cost of circulation space. Where a major college building programme is to be launched then it is worthwhile having the proposals examined expertly to see whether the total building costs can be reduced by the use of special designs for individual components and furniture.

21 Another change has been taking place in technical college work in recent years whereby equipment has gradually altered from that normally found in industry to that specifically designed for teaching purposes. The older, larger equipment is giving way to smaller but more specialised pieces and this in turn means some reduction in costs. In turn, of course, this will also reduce the size of some engineering laboratories particularly heat engines, hydraulics and electrical machines. On the other hand much new equipment is coming forward in electronics, instrumentation, fluidics etc., which tends to offset the savings made elsewhere. Nonetheless, shopping for equipment with the new look will certainly help to keep capital costs down.

Recurrent Costs

22 I would like to spend a little time now analysing the recurrent costs in technical college work. The analysis will be rather perfunctory but will give some indication of what factors are involved. The costs fall into four main groups,

(*a*) the cost of academic staff;
(*b*) the cost of non-academic staff;
(*c*) the cost of tuition; and
(*d*) the cost of boarding.

The academic staffing costs are of course influenced by the ratio of staff to students, by the ratio of senior to junior staff and by changes in the rates of remuneration which occur from time to time. The ratio of staff to students as we have seen is normally of the order 15 : 1 in technician work but, in some overseas situations a lower figure, nearer 12 : 1, may have to be accepted because of the fact that smaller classes are the normal thing. The percentage of more senior staff will be greater for institutions concerned primarily with diploma-type technician work, lower for those offering a substantial amount of certificate type work and still lower if skilled level training is offered by the college. The academic salary element is also upset by the use of expatriate staff which gives an artificial boost to the figure. It is clear that for colleges offering a mixture of technician and skilled level work, the element is likely to be much more advantageous than for a purely technician-type institution.

23 The non-academic staff includes all office and administrative cadres together with laboratory, workshop, cleaning, ground, stores, etc., staff. The costs of such staff are influenced by a substantial increase in the overall numbers of students and by the development of new courses calling for new laboratories or workshops. They are also influenced by local changes in wage rates and can be influenced in some cases by mechanisation e.g. cleaning, grounds, office. The ratio of supervisory to other staff is only likely to affect the costs as the gross number of students increases.

24 Tuition costs can be divided first of all into two main groups:

(*a*) one that is only affected by relatively large changes in the number of students; and

(*b*) one that rises and falls regularly with the number of students.

The first group includes the cost of services such as water, gas and electricity, the cost of cleaning, transport, grounds, office materials etc., and these are only seriously increased by a change in the number of buildings or the size of the grounds or some other factor arising from a planned increase in the overall size of the institution. The second group includes materials, paper, apparatus etc., used for tuition purposes and these obviously vary directly with the number of students. In an endeavour to isolate the more expensive courses the latter group can be further sub-divided into the per capita cost for types of course e.g. skilled level, junior technician, senior technician, clerical etc., and into full-time, part-time and evening categories. It is more appropriate in the latter case to use the student-hour cost, as a relationship is then possible between the three categories. The last item, boarding, again has two elements one for feeding and one for cleaning and this is convenient as non-boarders may also be served meals; again only the feeding part of this item varies directly with the student numbers and a per capita cost can be determined, the cleaning element being added to the non-variant tuition costs.

25 This kind of analysis can only yield real dividends some years after it has been launched but once regular costings have been determined the institution can then determine the grants it needs very clearly and with complete confidence. The salary grants for academic and non-academic staff will be easily estimated, from the increases in staff required for the forthcoming year; the non-variable costs will be fixed assuming no major student increase is involved and can be stated, whilst the tuition and boarding per capita costs will have by that time

been established and the grants required can be simply determined from the student numbers expected. Here then is a way in which the costs can be analysed and watched and from which estimates can be readily determined both within the college and by the board or the Ministry.

Development Planning

26 The emphasis in this Conference is on planning; economic planning and manpower planning. It should therefore be a relatively easy matter for an institution together with its board of governors and Ministry to think ahead a few years and to plan its courses and staffing and student numbers over three years using the per capita and other costs discussed in earlier paragraphs; it should then be possible to predicate the funds needed by the institution over a period of three years. If this can be agreed in principle by the board and by Government then the principal of the institution can plan his forward moves and recruit new staff with much more assurance, and run his institution more efficiently and more economically.

Sources of Funds

27 The normal sources of funds will be Government grants, student and other fees and gifts from outside sources such as industry or a benefactor. In the case of Government grants there will of course need to be grant-in-aid rules governing the use of grants. In general this will mean that salaries grants will be exact and any balance must be repaid or held over to a following year and equipment or capital grants will be quite specific and cannot be used for other purposes.

28 The tuition and any boarding costs may well be calculated on the formula already discussed but any grant paid will be reduced to the extent of any expected fees or other grants. Any sums remaining over at the end of the year due, for example, to fewer students turning up than anticipated may be recalled but it is unusual; institutions or their boards of governors are normally expected to put such sums away in, for example, an equipment replacement fund.

29 Fees can be of two kinds, those collected from students and those obtained for any work done for industry or the general public. Where boards of governors have the power to raise their own tuition and boarding fees it is normal for this to be done in concert with the Ministry and other institutions; it is also usual to relate the fees to the tuition and any boarding costs so that any rise in these can be passed pro-rata to the fees in a readily explicable manner. The two elements are always subsidised these days but at quite different levels, the tendency being for the student in many boarding institutions to be asked to meet the feeding costs alone or in non-boarding institutions to pay either nothing or a nominal fee. Even where he is expected to pay the fee he is more often than not able to obtain a student loan, bursary or scholarship. It is considered by some that after subsidy, the amount required to be paid by the student is so small as to be negligible and not therefore worth collecting but this overlooks a very important fact of human nature. Students will only value the training they receive if they have to pay for it and the value in their eyes increases with the increase in the payment made. For this reason the loan concept is a far better idea than 'free' technical education. Thus a student in some countries seeks a loan either from Government (which may use a revolving fund for the purpose), or industry or some other organisation from which he pays his fees and keep, until he obtains

his first job when he is expected to begin repayment. Alternatively industry or Government may pay the fees on the understanding that the student returns to them for a specific period of years, i.e. he bonds himself to the firm or to Government. Again an institution may arrange its teaching programme so that the student has a half-day off during which he can work. The student may of course obtain a traditional bursary or scholarship, and on part-time and evening courses employers often meet the fees in retrospect. The students' parents can of course take out an insurance too from which they can meet his fees and there seem to be considerable possibilities in this kind of approach.

30 There are a number of other ways in which an enterprising principal and his board can acquire money or books or equipment as gifts and grants from industry, professional organisations or foundations; also a board of governors may either raise money by means of a loan, from a private body or by public subscription, with Government approval, and apply this to the capital development of the institution. Again such a board can invest grants provided in advance of need, or other savings, in short term bonds, and gradually build up a respectable sum in this way. This is encouraged by many Ministries on the understanding that the board of governors replaces worn equipment from its own resources or carries out small capital programmes such as, for example, a football pavilion, itself, whilst Government will provide new equipment and be responsible for major capital development work.

31 This paper has inevitably covered a great deal of ground, some of it common to earlier papers but this has been necessary to give a clear, integrated picture, and I hope provide you with ammunition for further discussion.

APPENDIX

Draft Constitution and Rules for a Board of Governors

'COUNTRYLAND' TECHNICAL COLLEGE

Introduction

1 The Countryland Technical College is established to provide training within the framework of the approved policy for technical education for such skilled and intermediate level workers as are needed from time to time to meet the manpower requirements at these levels in Countryland.

2 The Board of Governors of the Countryland Technical College is established in order to provide for the founding, maintenance, development and governance on a continuing basis of the Countryland Technical College in such a manner and at such a level as will ensure the achievement of the aims expressed in Rule 1.

3 The Board of Governors shall be constituted in the manner provided for by these Rules and shall have such functions, powers and duties as are provided for by these Rules.

Interpretation

4 In these Rules unless the context otherwise requires:

'Board' means the Board of Governors established by Rule 2;

'Minister' means the Minister for the time being responsible for education in Countryland;

'Permanent Secretary' means the Permanent Secretary for education in Countryland or one of his duly authorised assistants;

'Chairman' means Chairman of the Board;

'Vice-Chairman' means Vice-Chairman of the Board;

'Clerk' means Clerk to the Board;

'College' means the Countryland Technical College;

'Principal' means Principal of the Technical College;

'Staff' means Staff of the Technical College;

'Student' means any student of the Technical College;

'Trustee' means any Trustee of the Technical College.

Constitution

5 The Board shall consist of:

(*a*) a Chairman and Vice-Chairman each of whom shall be appointed by the Minister;

(*b*) not more than fifteen members representative of the industrial, commercial, professional, educational and Government interests involved, appointed by the Minister;

(*c*) a non-voting Clerk to the Board who shall normally be the Principal.

Term of Office

6 The terms of office of members of the Board shall be as follows:

(*a*) the Chairman and Vice-Chairman shall hold office for a period of three years from the date of their appointment and shall be eligible for re-appointment;

(*b*) members shall serve for a term of three years and shall be eligible for re-appointment;

(*c*) The Minister:

(i) shall remove from the Board any member who becomes a bankrupt or makes an arrangement of composition with his creditors generally or is incapacitated from acting or who is convicted of any criminal offence involving moral turpitude or ceases to be resident in Countryland or who communicates to the Chairman or Clerk a wish to resign;

(ii) may require any Governor who is absent from all meetings of the Board during a period of one year to resign from the Board;

(iii) may in his discretion require the Chairman, Vice-Chairman or any member to resign his appointment to the Board.

Vacancies

7 (*a*) (i) Every vacancy on the Board shall as soon as possible be notified to the Minister who shall take the necessary steps to fill it;

(ii) a member appointed to fill such a vacancy shall hold office only for the unexpired term of office of the member in whose place he is appointed; he shall notwithstanding be eligible for re-appointment;

(*b*) in the event of the Chairman being temporarily unable to perform the functions of his office the Vice-Chairman shall act in his stead; where both the Chairman and the Vice-Chairman are absent then the members of the Board shall choose one of their number present to act as Chairman for the time being;

(*c*) in the event of a member being temporarily unable to perform his functions as a member the Minister may appoint such person as he thinks fit to act as a member of the Board for the period of absence of the substantive member.

Pecuniary Interest

8 No member of the Board shall take or hold any interest directly or indirectly in any property belonging to the College otherwise than as a trustee for the purpose thereof nor without the specific approval of the Minister in writing receive any remuneration for his service as a member. If in relation to the affairs of the College a member of the Board should be interested directly or indirectly in any contract or proposed contract he shall declare his interest at any meeting at which he is present and shall withdraw from the meeting for the duration of the discussion in relation to such contract.

Vice-Chairman

9 The duties of the Vice-Chairman shall include acting for the Chairman during the latter's absence and such other responsibilities as the Chairman with the approval of the members may determine.

Committees

10 (*a*) To assist the Board in the efficient conduct of its business there shall be the following standing committees appointed annually by the Board from among its members:

(i) General Purposes Committee composed of a Chairman and not less than five members elected by the Board;

(ii) Finance Committee composed of a Chairman and not less than five members elected by the Board;

(*b*) the Chairman and Vice-Chairman shall be ex-officio members of these Committees;

(*c*) the terms of reference of the Committees shall be determined from time to time by the Board including the delegation to a Committee of such of the Board's functions as it may deem appropriate;

(*d*) the Board may set up any other Committee it deems necessary.

Board of Studies

11 (*a*) There shall be a Board of Studies for the College composed of:

(i) the Principal as Chairman;

(ii) the Heads of Departments and Sections as Members;

(iii) the Registrar as Secretary;

(*b*) the function of the Board of Studies shall be to advise the Principal and the Board of Governors on all matters relating to the academic functions of the College, together with such other matters affecting the operation of the College as may be determined by the Principal or by the Board in consultation with the Principal.

Meetings

12 (*a*) The Board shall meet not less than once in each year for the transaction of its business and one such meeting shall be on the campus of the College;

(*b*) the Board may be convened at any time by the Chairman to discuss a specific subject and shall be convened for any such purpose at the request of six members addressed in writing to the Chairman.

Power to Co-opt Members

13 The Board shall be empowered to co-opt such persons as it may consider desirable for the transaction of its business to any meeting of the Board or of its Committees; such persons shall have no power to vote.

Absence of a Chairman of Committee

14 When the Chairman of a Committee is temporarily absent the members present shall elect one of their number to be Chairman.

Minutes

15 (*a*) Minutes of the proceedings of the Board and of its Committees shall be kept in an appropriate form;

(*b*) all proceedings of the Board and of its Committees shall be regarded as confidential unless the Chairman rules otherwise;

(*c*) all such minutes shall be distributed to each and every member of the Board and to the Permanent Secretary.

Voting

16 Any decision of the Board or of any of its Committees, except as otherwise provided for in these Rules shall be by simple majority; the Chairman of the Board or of any of its Committees shall have a deliberative and a casting vote at any meeting of the Board or of such Committee at which he exercises the functions of a Chairman.

Quorum

17 (*a*) There shall be a quorum when six members are present at any meeting of the Board except as otherwise provided in these Rules;

(*b*) there shall be a quorum when three members are present at any meeting of a Committee of the Board.

Emergency

18 In an emergency the Chairman or in his absence the Vice-Chairman shall take such action as he deems appropriate to the circumstances provided he subsequently calls a full meeting of the Board at the earliest possible opportunity.

Functions of the Board—General

19 (*a*) It shall be the duty of the Board to govern the College in accordance with the provisions of these Rules;

(*b*) in the exercise of its functions the Board shall consult the Principal and on academic matters shall take into consideration the views of the Board of Studies of the College;

(*c*) the Board shall require from the Principal at least once in each year a report on his conduct of the affairs of the College which shall include such information as the Permanent Secretary may request; the Board shall pass a copy of the report to the Permanent Secretary as soon as possible after the end of the academic year;

(*d*) the Board and its members individually shall endeavour to promote liaison with industry, commerce and the general public.

Functions of the Board—Staffing

20 (*a*) The Board shall from the commencement of these Rules assume functional control of the Principal and all teaching and non-teaching staff already employed at the College at such time and for such periods as may be mutually agreed between the Board and the Permanent Secretary;

(*b*) thereafter within salary scales and general conditions of appointment agreed with the Government the Board shall ensure that qualified staff are appointed in adequate numbers to fill vacancies on the establishment of the College for academic and non-academic staff;

(*c*) where the Board is unable to recruit suitable staff for the adequate staffing of the College it may request the Permanent Secretary to make good the deficiencies by arranging the secondment of Public Officers for service under the functional control of the Board for such periods as may be mutually agreed. The terms of such secondment shall be in accordance with such regulations as may be in force for the time being relating to the secondment of Public Officers;

(*d*) the Board may delegate to the Principal the appointment of junior categories of staff;

(*e*) no person employed by the Board shall be dismissed or have his contract of employment terminated without an opportunity of appearing in person before the Board, provided however that no person appointed by the Principal under the powers delegated to him by the Board under Rule 20 (*d*) hereof shall have such a right;

(*f*) any resolution of the Board to dismiss a Principal appointed by the Board shall only be valid when:

(i) it has been passed at a special meeting convened for the purpose of which thirty clear days notice shall be given by the Chairman in writing to each member of the Board, in which the motion to remove the Principal shall be clearly set out;

(ii) not less than twelve members are present in person;

(iii) it has been passed by a majority of at least four votes;

(iv) the Principal has had an opportunity of appearing in person before the Board to present his case;

(*g*) if the Board desires to terminate the secondment of a Public Officer a resolution to this effect shall be sent to the Permanent Secretary;

(*h*) the Board may make such arrangements as it deems necessary to enable members of its staff to submit their views or make representations to the Board on any matter.

The Principal

21 In the exercise of its powers the Board shall not encroach upon the proper field of responsibility of the Principal of the College. The duties of the Principal of the College are as follows:

(*a*) he is the chief academic and executive officer and is responsible to the Board for the academic, social and domestic organisation and conduct of the College;

(*b*) he shall arrange the academic curriculum and syllabus of the College having due regard to such general instructions as the Board may from time to time give;

(*c*) he shall arrange the admission of students to the College and be responsible for the collection of College fees;

(*d*) he shall have the power to exclude, suspend or expel any student from attendance at the College for any cause which he considers adequate provided he shall be required to report the circumstances of any suspension or expulsion to the Board at its next meeting;

(*e*) he is responsible for day-to-day expenditure on the maintenance of the College and he shall either personally or through his authorised assistants, present an account of such expenditure to the Board as and when it may direct;

(*f*) he shall have the authority to report or recommend to the Board any disciplinary measures against any member of the College staff.

Inspection

22 The College shall be open to inspection by duly authorised officers of the Ministry of Education; any inspection report in respect of the College shall be submitted by the Principal to the Board, together with his own comments thereon.

Functions of the Board—Finance

23 Within the limits of available finance the Board shall meet all expenses connected with the running of the College and shall ensure that the College is properly maintained.

24 (*a*) The Board will receive funds on behalf of the College:

(i) from Government by way of grants-in-aid from public funds;

(ii) from students of the College by way of fees charged at rates laid down by the Board with the approval of the Permanent Secretary;

and apply them for the maintenance, development and administration of the College PROVIDED ALWAYS that such grants-in-aid from Government shall be applied strictly for the purpose for which they are made;

(*b*) the Board may also receive funds on behalf of the College from any other source by way of gifts and grants or endowments provided that if acceptance of such gifts, grants or endowments would entail the expenditure of public funds the Board shall first consult the Permanent Secretary.

Loans

25 The Board may subject to the approval of the Minister raise loans from private sources to meet capital expenditure.

Accounts

26 (*a*) The Board shall cause proper books of account to be kept with respect to:

(i) all sums of money received and expended by the College and the matters in respect of which the receipt and expenditure takes place;

(ii) all assets and liabilities of the College;

(*b*) the books of account shall be kept at the administrative offices of the College and shall always be open to inspection by members of the Board;

(*c*) the Board shall cause to be prepared and laid before it annually an Income and Expenditure account and Balance Sheet together with the auditor's report thereon;

(*d*) the Chairman of the Board shall cause to be sent to the Permanent Secretary not later than four weeks after the date of the Board meeting at which the accounts are adopted, a copy of the said Accounts and Auditor's Report.

Reserve Fund

27 Any excess of income over expenditure at the end of any one financial year shall be appropriated to a General Reserve Account where it will remain until the end of the subsequent financial year. At the end of that year the amount of the General Reserve Account less the sum required to make good any excess of expenditure over income in that subsequent financial year may either be carried forward to accumulated funds or appropriated in whole or in part to a special reserve fund at the discretion of the Board. The special reserve fund may only be applied to meet any extraordinary claim or demand arising at any time against the College or in payment of the cost of extending or improving any part of the property or equipment of the College or otherwise for the benefit of the College provided that where such expenditure would commit Government to the expenditure of public funds, the approval of the Permanent Secretary be sought beforehand. A sum equivalent to the amount set aside in the special reserve fund shall be invested in readily realisable assets.

Depreciation Fund

28 The cost of renewing any part of the property or equipment of the College shall be charged to a Depreciation Fund account established for the purpose.

Tied Grants

29 Where Government grants paid to the Board are in respect of salaries, such grants shall be paid into a salaries grant reserve account. If the relevant expenditure is less than the cost on which the grants were based only an amount equivalent to the actual expenditure shall be treated as income of the College. Where Government grants paid to the Board are in respect of capital expenditure and purchase of equipment such grants shall be paid into a capital expenditure reserve account and an equipment reserve account and shall not be treated as income of the College. At the end of the financial year an amount equivalent to the expenditure incurred on capital projects and purchase of equipment shall be appropriated to accumulated funds. If the relevant expenditure is less than the cost on which the grants were based, unless otherwise provided for in the terms on which the grant was made, the excess of grants actually paid over the sums to which, according to actual expenditure, the Board is entitled shall remain in the reserve accounts to be either offset against subsequent Government grants or repaid to Government.

Estimates

30 (*a*) The Board shall prepare and lodge with the Permanent Secretary annually, by a date which he shall notify, annual estimates of income and expenditure upon which Government grants-in-aid will be based. Such estimates shall be in a form agreed with the Permanent Secretary and will require his approval;

(*b*) expenditure shall be in accordance with the estimates either as originally approved by the Permanent Secretary or as varied by reallocations or supplementary estimates also approved by the Permanent Secretary provided that the Board may at its own discretion increase or decrease the provision under any item of recurrent expenditure by a maximum of 10 per cent of the original estimate for that item. The Permanent Secretary may approve reallocation without financial limit.

Fees

31 The policy of the College as regards fees, bursaries and other charges shall be the responsibility of the Board acting with approval of the Permanent Secretary.

Auditors

32 The accounts of the Board shall be subject to an annual audit by an auditor appointed by the Board subject to the approval of the Minister.

Trustees

33 (*a*) The Board is empowered to appoint trustees in whom shall be vested the funds, buildings, land and equipment of the College;

(*b*) the trustees shall deal with all property for the time being vested in them and the rents and profits thereof in such manner as the Board may direct subject to these Rules or to the conditions upon which any donation or endowment is made to the College.

Dispute

34 Where there is any doubt as to the interpretation of these Rules the matter shall be referred to the Minister whose interpretation shall be final and binding on all parties.

Report of Working Group A(6)
Administration, Finance, Control and Inspection

Chairman: Mr. N. R. Edwards (Australia)

Terms of Reference

1 The terms of reference of this group were: 'The Administration, Finance (including assistance for students), Control and Inspection of Technician Education and Training Programmes.' As a basis for its work the Group took the lead paper presented by Mr. J. W. Gailer.

Assessment of Needs

2 The system of technical education and training is a vital factor in each country's economic development and has a direct relationship to the well-being not only of the economy of the country as a whole, but also to that of each individual citizen. It is, therefore, of the greatest importance that the resources both of men and of materials should be accurately assessed and that on the basis of this assessment a national 'Declaration of Intent' should be formulated, forecasting for a reasonable length of time the main lines of the country's economic development. National plans will differ widely in their content and objectives since the basic resources and potentials of the countries comprising the Commonwealth vary widely. Some countries are self-sufficient and need little outside aid; some have vast industrial potentialities; others must remain predominantly agricultural in the foreseeable future, It is only the government concerned which can collect the essential factual and statistical evidence, calling in expert advisory assistance whenever this can be helpful. There is a close and fundamental link between technical education and training, manpower and the country's economy. Technical education, and technician training as a part of it, must be seen as an essential element in achieving the objectives of the national 'Declaration of Intent'.

Aims of Technical Education

3 Two points must be stressed here. In the first place, although technician education is directed primarily towards the economy, by making better technicians, it is also tending to make better citizens and thereby fills a social as well as an economic purpose. In the second place, a system of technical education and training should be regarded as an integral part of the general system of education. What is done in all other parts of the education sphere directly affects the efficiency of the technical education system.

4 Since technical education is concerned with securing greater industrial, agricultural and commercial efficiency, it follows that industry, agriculture and commerce have a responsibility in helping to devise, maintain and extend an adequate system of training.

Administration

5 Although it has been contended in some quarters that technical education and training are the function of industry alone, this point of view is hardly acceptable. Technical education and training will make greater strides when government and industry, embracing both employers' and employees' associations, are in partnership. Industry, indeed, should be consulted not only on the kind of courses needed in technical institutions but also on the actual content of the curricula. This partnership may find its expression in the form of national or local boards with purely advisory functions, or of national or local boards or councils with certain executive powers and functions.

6 The form which the method of controlling and administering the technical education system of a country takes will depend to a large extent on the conditions obtaining in the country itself. It would be quite impossible and wholly undesirable to lay down any uniform system applicable to countries as varied as Canada, India, Nigeria, and Cyprus.

7 Among the many systems of control and administration of technical education which are practised the following may be noted:

(*a*) central control by a government ministry or department ensuring the swift enactment of official policy, but which may leave little freedom to the individual institution;

(*b*) control by national or regional boards concerned either with technical education as a whole or with education and training for individual or grouped industries. Alternatively, separate boards may be established for different levels of training, e.g. at craft, technician, and professional levels;

(*c*) control, which may be delegated in part to the individual teaching institution, through the medium of a governing body representative of local industry or commerce and, where considered appropriate, of the government ministry or department concerned.

8 The particular system or combination of systems adopted in any one instance will depend upon national and local circumstance, but the ultimate aim should be to permit sufficient flexibility for the individual institution to meet local needs within the framework of overall government policy.

9 Flexibility in planning is essential in developing countries and in certain instances, where it is not feasible to establish separate facilities for the various levels of technical education, it may be desirable to develop technician education and training within the framework of a local university institution. In other circumstances it may be preferable to develop or establish a polytechnic type of institution which would cater for all middle level technical education and training. Out of this, in time, could evolve according to need one or more professional level courses whose cost would be absorbed in the wealth of lower level work. Where technician work has to be included in the work of a traditional type of university, there is much to recommend the view that it should be provided in a separate institute or department of the university so as to ensure that the technician suffers no loss in prestige, that specific finance can be made available, that close contacts with local industry can be maintained and staffing problems can be minimised.

10 Whatever the form of administration of technical education, the Group agreed on the need for a distinct technical education unit. This unit should fit into the education system as a whole in such a way as to leave no doubt as to the importance of technical education. When there are separate ministries involved, arrangements should be made for co-ordination between them.

Control and Inspection

11 Some form of accreditation and inspection is essential in order to ensure the setting and maintaining of satisfactory standards. The exact form will depend upon the state of the country's development as well as upon the technical and educational needs, and smaller countries may well need to have recourse to regional solutions or to using an outside institution or body for this purpose.

Finance

12 No country has unlimited resources to devote to technical education and training and it is, therefore, of fundamental importance that the various costs should be carefully and fully analysed in order to secure the most economical use of the funds available.

13 The first consideration must necessarily be given to *Capital Costs*. Much capital is, of course, sunk in the buildings in which the training and education are given. In some cases buildings seem too elaborate and ornate for the purpose they have to serve and the criterion in the design and construction of any building should be its function. This is not to argue that such buildings should be devoid of aesthetic appeal, but it is a mistake to try to erect, in developing countries, buildings which are appropriate to the economic conditions of developed countries and which in no way reflect the very different conditions and aspirations of an indigenous culture. Similarly, it is a mistake to acquire machinery of a large or heavy type which has little or no value as a teaching device.

14 Secondly, there are *Recurrent Costs*. Some of these will vary with the number of students as, for example, the cost of materials. Others will tend to remain constant, for instance the cost of electricity for lighting. Under one or other of these headings will fall the cost of the teaching staff, the cost of the non-teaching staff, the cost of teaching material and apparatus, the cost of maintenance services and the cost of boarding.

15 The financial estimates of a British College of Technology are set out in an Appendix to this report.

16 Formal planning of courses, together with the necessary staffing and other recurrent costs, is essential both for new and existing institutions. The majority of full-time courses are of two or more years' duration and for this reason, as well as to enable an institution to make such planning effective and avoid a hand-to-mouth existence, the necessary funds should be predicated for a specific period ahead (say three years) and agreed with the financial authorities involved. Subject to the overall provision of funds in the country's or organisation's annual budget and to any need to correct for the effects of external influences such as salary awards, money will then be available in sufficient quantity to make ordinary development possible.

17 The question of sources of funds in general was also considered. The lead paper presented by Mr. Gailer together with the paper submitted by the International Bank for Reconstruction and Development[1], were used as bases for discussion. The main sources of funds were seen to be government grants, student and other fees, possibly industrial levies, as well as grants and loans from various donor agencies and gifts from outside sources such as industry or a benefactor. Industry will normally make a contribution either through taxation or levies or both. As far as taxation is concerned, the contribution from industry is usually not specifically earmarked for technical education and training but inevitably some part of it is directed to this end.

Assistance for Students

18 There has been some argument in recent years that all education and training (including technical education and technician training) should be completely free of cost to the student. There was some difference of opinion about this view but, on the whole, the Group thought that the commitment of the student to pay a fee, however small, could be a desirable form of motivation. To make some little sacrifice to acquire his technical education was also felt to be of use in character formation.

19 Assistance should, however, be given to worthy students when there is a proved need. This best takes the form of competitive scholarships and bursaries from their own government or from donor agencies. Another form of assistance is the loan which the student undertakes to repay over a period of years after the completion of his course. Here the dangers to avoid are:

(*a*) making the repayment of the loan a millstone round the neck of the student when he embarks on his carreer;

(*b*) extending the period of the loan over too long a period.

20 In any case, the loan will never be an economic fee for the course from which the student benefits. The Canadian system, whereby the student through the instrumentality of the education authorities obtains his loan from a bank, has much to commend it. For one thing the difficult matter of collection is considerably simplified and the student is likely to feel that his relations with a financial house are legally rather more binding than his relations with an education authority.

21 Finally, there is the system whereby the student is financed in his technical education and training by his firm, on condition that he undertakes on completing his training to work for the donating firm for a given number of years. This system, often known as 'cadetship' or 'bonding', is common in Australia and some other countries but is tending to die out in others such as Great Britain.

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[1] Conference Paper C.E.T.T.(P) 7/5 (See Appendix II).

APPENDIX

A BRITISH COLLEGE OF TECHNOLOGY

FINANCIAL ESTIMATES 1965/1966

	Estimated No. of students
Full-time	850
Part-time Day	2,100
Evening	4,350
	7,300

Expenditure

		£
Salaries and Wages		
TEACHING STAFF (170)		275,700
ADMINISTRATIVE AND CLERICAL STAFF (20)		15,500
OTHER NON-TEACHING STAFF (22 part-time—33 full-time)		19,560
CARETAKERS AND CLEANERS		18,460
Premises and Grounds		
BUILDINGS	£	
Maintenance	4,900	
Special Items	1,820	
Painting	1,230	
		7,950
GROUNDS		
Maintenance	2,360	
Special Items	2,160	
		4,520
FUEL, LIGHT, CLEANING MATERIALS AND WATER		14,180
FURNITURE AND FITTINGS		
Maintenance	1,420	
Special Items	3,405	
		4,825
RENTS		4,510
RATES		14,100
Equipment		
Maintenance	3,000	
Special Items	26,925	
		29,925
Carried Forward:		£409,230

			£
Brought forward			£409,230
Books, Stationery and Class Materials			27,040
Laundry and Towels			960
Office Expenses		£	
Printing, Stationery, Postages, telephone etc.		3,875	
Equipment—general		200	
Special Items		720	
			4,795
Travelling Expenses			200
Insurances			450
Functions and Activities			500
Examination Fees			6,300
Meals			1,275
Miscellaneous			1,320
			£452,070
Income			
Sales	£		
Handiwork, etc.	2,000		
Meals	650		
Catering Unit	1,650		
Canteen	300		
		4,600	
Fees		22,000	
Rents		120	
			26,720
			£425,350

APPENDIX

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Insurances		450
Functions and Activities		500
Examination Fees		6,300
Meals		1,275
Miscellaneous		1,320
		£452,070

Income

	£		
Sales			
Handiwork, etc.	2,000		
Meals.	650		
Catering Unit	1,650		
Canteen	300	4,600	
Fees		22,000	
Rents		120	26,720
			£425,350

Discussion of Report in Plenary Session

The importance of considering technical education as an integral part of a country's educational system, within which it should have a clearly identified place and parity of esteem with other forms of education, was emphasised. It was considered important that those concerned with administering technical education should be sympathetic to its aims and, whilst overlapping responsibilities between two or more departments of government were thought to be unavoidable, it was stressed that duplication of effort should be avoided. Close and active co-operation with industry and liaison with other organisations is vital for the development of technical education.

The best form of control and administration is that which leaves the individual institution a considerable measure of responsibility and autonomy. Whilst this may, in many cases, be difficult to achieve in the initial stages because of local conditions, it should be regarded as the ultimate goal of an essentially evolutionary process of development.

There was no consensus of opinion on the overall effectiveness of developing technician education and training under the 'umbrella' of a university-type institution. It was thought that this approach may be justified in certain circumstances, particularly in countries having limited resources, but very careful planning is required to ensure that the real needs of technician education are not lost sight of in building up this type of university institution. The lessons from past failures with this approach should be carefully studied and care taken to avoid repeating their mistakes.

Considerable emphasis was placed on the importance of making adequate provision to cover the recurrent costs of an institution in order that it might operate effectively and efficiently after it has been established. These recurrent costs, which usually have to be borne by the local government, are far greater than the initial capital cost which may be provided from aid sources: unless there is a preparedness to meet the running costs for a number of years and to make available sufficient funds for this purpose, the result is a serious waste of capital.

CHAPTER X

Six working groups 'B' were established to consider the educational and training needs of specific types of technician, and to prepare a report for discussion by the Conference in plenary session. Only 6½ hours of Conference time were available for each working group 'B', although many groups decided to devote some of their free time to additional meetings. It was left to the Chairman and members of each working group to decide how they wished to tackle their subject and the form in which they wrote their report; no attempt was made to impose a uniform pattern and the variations in the reports which follow reflect the different interpretations placed on the phrase 'educational and training needs' by the working groups.

Report of Working Group B(1)

MECHANICAL AND ELECTRICAL ENGINEERING TECHNICIANS

Chairman: Dr. B. C. Lee (New Zealand)

1 It was agreed that the working group should select certain items from the topics dealt with by the lead speakers, and regard these as the nucleus for a discussion of their relevance to Mechanical and Electrical Engineering Technicians.

Role of the Employer

2 The role of the employer varies according to the type of course being undertaken by the student but he has an important role to play in the training element of all courses; in some cases he may be responsible for both education and training.

3 Some employers are unwilling or unable to play their part in providing and financing training, and full co-operation on the part of employers may not always be forthcoming. Developing countries in particular are anxious to receive advice on the methods which may be used to stimulate interest among employers, and to motivate employers so that this problem may be overcome.

4 The employer has an important part to play in making available equipment which cannot otherwise be provided. The ever-increasing content of project work in technician courses emphasises this need for equipment and apparatus and where, as in many developing countries, it is not possible for employers to provide the right equipment, the technical colleges will have to do more in this direction.

5 The importance of the employer in every branch of technician training and education cannot be over-emphasised. He should be, and is, represented on advisory and curriculum committees, national committees, governing bodies and examining councils.

6 The employer should share in the responsibility for the assessment of students. Personality and ability evaluations are important in placement after training, transfer and promotion.

7 Industry should be approached to help in identifying the occupational requirements of technicians, full use being made of the employer's expertise and knowledge. The employer can play an important part in ensuring an adequate integration of school, home and industry: the development of induction courses for new technician students may be of great value in this connexion.

8 The working group stressed that in outlining these requirements and responsibilities of employers in the design, establishment and operation of technician courses, the responsibilities of the colleges must not be subordinated to those of industry.

Consultative Machinery

9 The use of advisory committees is supported and a wide range of interests should be represented.

10 Although the function of these committees is advisory, it is important that their members are consulted and involved to an extent sufficient to hold their interest. An ad hoc committee may be considered useful when a new course is started.

11 The working group favoured separate committees for technician and craft courses, but if this pattern is to be used co-ordination between the committees is recommended.

Status of Technicians

12 Government and industry should work together in an attempt to improve the status of technicians. Pay and status go hand-in-hand, and an appropriate pay structure for technicians is important.

13 The status of technicians is likely to be enhanced if they organise themselves into occupational associations. In this they may need the assistance of the professional engineering institutions. In some countries it may be possible for such organisations to negotiate salary awards for the benefit of members, and this helps to improve their status. In one country senior engineering technicians are voluntarily registered by a statutory body; in others, professional institutions have introduced an associate qualification to denote technician status.

14 It was generally agreed that examination success would not of itself ensure technician status.

Selection of Technicians

15 The working group discussed the prerequisites for the selection of technicians, recognising that they occupied a spectrum of positions between technologists and craftsmen.

16 School performance should play a role in placing students of technician potential within this spectrum but entry requirements will vary according to the system established in a particular country.

17 It is difficult to lay down any hard and fast rules for academic attainment. A guide would be success at approximately G.C.E. 'O' level or its equivalent in (say) three or four subjects including English, Mathematics and Science (preferably Physics). Technical Drawing would also be useful providing that it has been well taught.

18 Notwithstanding these general requirements, the door should not be closed to the able student who has taken inappropriate subjects at school.

19 Craftsmen who show promise, and those who have found a technologist course too much for them, should be able to transfer to a technician course.

20 Specific recommendations made by the group are that:

(*a*) Career counselling and pre-vocational courses should be developed.

(*b*) School reports should be used in selecting students and in placing them on courses, and the assistance of the colleges should be sought by employers when selecting potential technicians.

(*c*) Validated selection tests should be used more frequently and the selection process should not be a 'one-off' occasion. It should be considered as a continuous appraisal for about three to six months.

(*d*) Machinery should be set up which, while not repeating the functions of other establishments, should purvey information on research which has been carried out.

Design of Courses and Assessment of Success

21 Courses must be carefully planned to fit as closely as possible with known and expected needs. A factor in assessing such needs is a continuing demand for existing courses.

22 A system of feedback is of the greatest importance. Information should be supplied directly by industry and contacts resulting from collaboration between teachers and industry can also provide relevant information. Teachers should be in constant contact with students during their industrial training periods, and industry should be similarly in contact with students during their college periods.

23 The success of courses and their possible adaptation to meet changing needs should be checked as frequently as possible.

Types of Courses

24 The knowledge required by technicians is ever increasing and at a faster and faster rate: to cope with this problem there will be a demand for more and more time for courses.

25 The working group recognised the importance of full-time integrated courses and unanimously agreed on the merits of sandwich courses for technicians.

42 Salaries must be comparable to those offered in the Civil Service, industry and commerce to ensure that able people are attracted and industry must be educated to regard those it loses to education as its 'seed corn'.

43 Even the best teachers will not be as effective as they should if they are not adequately supported by workshop and laboratory technicians and by other assistants.

44 Conditions vary so widely that it is not possible to lay down scales of establishments, but the aim should be to see that all machinery and equipment is kept in good working order, that teaching aids are constructed and that laboratories and workshops, and their contents, are kept clean and tidy in a workmanlike fashion.

45 Technicians may also be required to assist in research projects and to operate machines (e.g. a materials testing machine) for students while a teacher is engaged with other students.

46 There may be need for other kinds of ancillary staff, such as clerks and stenographers, to support the teachers and to allow them to devote as much of their time and energy as possible to the work that only they can do.

Discussion of Report in Plenary Session

Introducing the report, the Chairman of the Working Group emphasised that technical education is meaningless unless it is related directly to the needs of industry. To enable the development of constructive co-operation between industry and educational institutions it is essential that there should be an effective system of 'feedback' so that technician education may be evaluated and any necessary corrections made.

The report paid particular attention to the need, especially in developing countries, for lists of equipment and other specifications, with an indication of sources of supply, and for recommendations on suitable text-books. A number of delegates indicated that some information on these lines is available and specific mention was made of the School Science Equipment Centre in Britain, which provides tests and reports on equipment. Some investigation into standard equipment lists has been carried out in Britain and these would be made available to other Commonwealth governments on request to the Department of Education and Science: there are dangers, however, in relying too heavily on standard lists since this can lead to fossilisation and a lack of flexibility in development.

The importance of providing adequate bridges between secondary education and technical education was recognised and references were made to the Malaysian system of providing preparatory practical courses in secondary schools as a means of giving a technical orientation to students, and to the Scottish practice of providing a range of courses at secondary school level. Some concern was expressed lest secondary school courses become too vocational and too technically biased, which would be harmful educationally, and the need for technical drawing and other technical subjects to be taught by teachers with practical experience in industry was stressed.

Report of Working Group B(2)

AGRICULTURAL TECHNICIANS

Chairman: Mrs. F. Bolton (Britain)

Introduction

1 It is now generally recognised that a rapid increase in food production is vital not only as a foundation for all industry, but for the actual survival of the majority of the world's increasing population. In a recent FAO report Dr. Sen referred to the fact that 'In 1965–66 world food consumption failed to rise but population increased by 70 million'. The United States Secretary of Agriculture recently stated that the United States is no longer a surplus wheat country, and that within 20 years this could mean a world food shortage unless food production rose to meet population growth. Lord Todd, FRS, in a recent speech, emphasised that the bulk of the new food supplies must be generated within the developing countries themselves and that a great co-operative effort between developed and developing countries is needed in which self-help must play an increasing part.

2 To achieve the necessary revolution in both attitudes and techniques which will promote agricultural development, it is essential that agricultural technicians should be trained and qualified on terms comparable with those of all other major industries. The efficient planning of the whole structure of training and education related to the production, processing and distribution of food is of primary importance in this context. Training and qualification on equal terms with other technicians would enhance the individual status of agricultural technicians and assist in establishing agriculture on a firm industrial basis; one of the aims should be to establish equivalent wages and salary structures.

Definition and Role

3 The agricultural technician, who occupies an intermediate position between craftsmen and professional personnel, is, by the very nature of the work in which he or she is engaged, responsible to a large extent for the communication of modern agricultural techniques to the farming community. This is important in the Commonwealth as a whole since many farmers, who are self-employed and can be classified as craftsmen, are operating at subsistence level.

4 A detailed description of the role of the agricultural technician poses particular difficulties because of the diversity of conditions in the industry and the relative lack of specialisation in many areas.

Training

5 (*a*) It is emphasised that technician courses should have their own integrity.

(*b*) It is not possible to achieve fully satisfactory criteria with regard to training programmes for agricultural technicians without a detailed occupational analysis which takes account of local conditions. Clearly much more work needs to be done along these lines with the assistance of those engaged in training and in close co-operation with the farming communities concerned.

(*c*) It is essential that the education of the agricultural technician should enable him to master new techniques in a world of rapid technological change.

(*d*) Training should include both theory and practice, integrated at every stage, with particular emphasis on the instructional techniques suitable for extension work among rural populations.

(*e*) Full-time residential courses provide the most satisfactory background for training, but part-time and other types of courses involving various combinations of education and practical training can be utilised, provided that some period of residential training at an established institution is included.

(*f*) Humanistic studies including an appreciation of local cultures should be a required part of the curriculum on which the agricultural technician is examined. This will lay the foundation, during the process of instruction, for communication and human relations techniques which are vital to the role of the technician in a world of changing social attitudes and agricultural practices.

Administration

6 The Group agreed that responsibility for the administration of technician training in the field of agriculture should be clearly defined. There were, however, differences of view as to whether one ministry, such as the Ministry of Education, should have primary responsibility, or whether responsibility should be divided between two or more ministries. Nevertheless, in cases where responsibility is divided, it was unanimously agreed that co-operation between the ministries involved is essential.

Equipment and Research

7 (*a*) *Equipment* should be related to the needs of the country or area in which it is to be used and, wherever appropriate and possible, up-to-date equipment should be used in training.

(*b*) *Research.* Increased research is required into the needs of specific areas and the equipment suitable to meet them. This could be included during the training period in association with technologists, industry and external agencies.

Aid

8 In considering the forms of aid which either directly or indirectly affect the education and training of agricultural technicians, it is essential that there should be the closest consultation and co-operation between all aid-giving agencies, industries and government ministries within both the recipient and donor countries. This would avoid any wastage of equipment or of personnel due to insufficient knowledge of local conditions both human and material. Links should also be established on an increasing scale between institutions of training in agricultural techniques in different countries. Adequate briefing in local conditions and customs is indispensable for those taking up technical assistance assignments. Moreover, instruction in local languages, preferably given in the recipient countries, is also highly desirable, particularly for those serving in the field.

The Role of Industry

9 Industries associated with all aspects of the development of agricultural techniques should be involved at every level of training for technical qualifications. Those industries with sufficient financial resources to regard aid as a long-term investment should be encouraged to provide technicians, suitable equipment and training facilities, both within the industry itself and in the field. Consultation and discussion with ministries and others responsible for training within each region will ensure a two-way method of communication and channel of information, thereby creating a continuous modernisation of agricultural methods in all countries. The resulting rise in agricultural production and the expanding market for all types of agricultural equipment and materials would benefit not only the farming communities and industry but the world community as a whole.

10 *Conclusions*

(i) Immediate steps need to be taken to improve standards of agricultural technician training so that technicians in this field achieve a recognised status comparable with that of technicians in other industries.

(ii) Agricultural technician courses should have their own integrity.

(iii) Technician training programmes in agriculture must be based on an occupational analysis to ensure that the particular and practical needs of agriculture are met. This occupational analysis should be worked out in co-operation with those involved in the operations of agriculture at all levels.

(iv) The training of agricultural technicians should include the following:

   (*a*) A sufficiently broad base of education to prepare him or her to master new techniques in a world of rapid technological change.

   (*b*) Examinable humanistic studies to equip the technician with the ability to communicate new techniques and to influence social attitudes.

   (*c*) Practical field training which should be an integral part of courses for the attainment of qualifications.

(v) Equipment used in training programmes must be clearly related to the needs and conditions of the locality to be served. More research on this important subject is urgently required.

(vi) Adequate briefing on local conditions and customs is indispensable for expatriate technical assistance personnel engaged in the training of agricultural technicians because of the gap which exists between existing local practices and modern techniques in an industry which is predominantly rural. For this and other reasons links must be maintained between professional personnel and between agricultural, educational and research institutions in both developing and developed countries.

(vii) Industry should be involved at every stage in the planning and preparation of training courses and in conferences held to discuss these matters.

(viii) Because of the critical importance of agriculture to economic development and social well-being, it is recommended that Commonwealth countries give immediate consideration to holding, in the near future, a further specialist Commonwealth Conference to study in depth all aspects of agricultural education and training.

Discussion of Report in Plenary Session

The Chairman of the Working Group introduced the report and commented upon the lack of background information available in the field of agricultural technician training. Particular importance was attached to those recommendations of the Group which dealt with the need for humanistic studies in technician education, the problems of providing proper equipment related to particular local needs and conditions, the need for a proper understanding of local conditions and customs, and the suggestion for a further conference of experts to consider all aspects of agricultural education and training in greater depth.

There was general agreement on the importance of agriculture to the economies of nearly all the countries represented at the Conference, and considerable support for the suggestion that a specialist conference should be held in the near future. The Conference was informed that the FAO is considering the convening of a world conference on agricultural education but this is unlikely to take place before 1970.

The importance of humanistic studies and an appreciation of local culture and customs was agreed. Many traditional approaches to agricultural practice have a sound technical basis which, if it is not properly understood, can lead to wrong methods being adopted. Much can be done by the use of industrial and other techniques in agriculture and reference was made to the work of the FAO in introducing mass-production techniques to developing countries.

There is a lack of stimulus and enthusiasm in secondary schools for agricultural work and the agricultural technician also requires some form of follow-up training after the completion of an education and training course in an institution.

Report of Working Group B(3)

TECHNICIANS IN BUSINESS AND COMMERCE

Chairman: Mr. Arshad Ayub (Malaysia)

Terms of Reference

1 It was agreed that the Group should concern itself with:

(i) a definition and description of the term "technician" as applied to the field of business and commerce;

(ii) the qualities required of students undertaking technician level courses in this field;

(iii) the types of courses which exist and which could be made available with particular reference to the needs of developing countries; and

(iv) the forms of aid which could best be provided for the developing countries.

Definition of Terms

2 In considering a definition of the business technician it was thought appropriate first to examine the nature of business itself. While technology is concerned with designing, making, constructing and operating things, business is basically concerned with buying and selling. It may be mainly goods that are sold, as in those manufacturing industries which buy raw materials and sell consumers' goods; or services which are traded, as in such industries as banking, insurance or hairdressing; or a mixture of both, as when a hotel provides both meals and accommodation, or when capital equipment is sold along with a supporting technical service. Always at the heart of business are these activities of buying and selling. But only in the simplest kind of marketing businesses do they stand alone; many other activities go along with them.

3 Business in a modern economy requires more and more of such activities as investigating, forecasting, budgeting, comparing, assessing and estimating, which lead to plans and decisions about business operations. Another group of activities centre around communicating, persuading, promoting, organizing, administering, and recording, which are all concerned with controlling business operations and checking on the results. As well as preserving the assets of the business and ensuring that its operations run smoothly and efficiently, these activities have the function of supplying management with a flow of information for further plans and decisions. As industry becomes more technical, business and technology become linked and studies overlap. In addition, businesses often have certain legal obligations to meet such as producing accounts in accordance with company laws or for the taxation authorities.

4 Although the one-man business must do its best, no one man can normally be expected to undertake all these activities or to display all the qualities required. Some specialisation in business skills is part of the division of labour typical of a modern economy, and from this it follows that there can be no single all-embracing course of study for business. An accountant, as such, would not usually be an expert in marketing as well; a shorthand-typist might not also be a book-keeper; and so on: a comprehensive list of jobs in business would be a very long one indeed.

5 In addition to specialisation by kind of job, there is also division of labour by level of work. In thinking of levels of work in business and commerce, it is necessary to identify the level according to the job done. It is desirable that the qualifications of the persons doing the jobs should then match their responsibilities.

6 In the structure of jobs in business, there are many which require some specialist skill or technique but little more. These can be classed with the skilled jobs in technology for which the term "craft skills" is used. Such jobs as those done by typists, shorthand-typists and junior secretaries belong to this class; so does the work of many clerks, book-keepers, sales assistants, junior representatives, telephone operators, etc.

7 At the head of the business job structure we have the business technologists, namely the managers, the professional accountants, sales managers, marketing managers, senior buyers, controllers, directors, investment managers, consultants, etc. and their deputies and senior assistants. These are the people who have to control and plan business operations, and take the responsibilities that go with these activities.

8 Between these levels come the people who combine some specialist knowledge, experience or skills with additional responsibilities and the ability to work under the direct control of senior specialists and management. Jobs at this level are comparable with technician work in production and contain an element of supervision. Senior secretaries and personal assistants, office supervisors, sales supervisors, buyers, senior representatives, junior accountants, chief clerks, executives, senior specialist clerks, organisation and methods assistants, are business technicians, although many of them would not recognise the term, and a great deal depends on their efficiency. They are the people who have to keep business moving. In this context, the Working Group noted the definition of "technician" given in the Report of the Third Commonwealth Education Conference:

> TECHNICIAN—A person qualified in specialist technical education and practical training to work under the general direction of a technologist.[1]

9 The technician in business is often required to act in an advisory capacity to professional people. It is conceded that under certain circumstances a business technician might have full responsibility for a productive unit's financial affairs. A professional man, e.g. an architect, or a small manufacturing entrepreneur, may need an employee trained in business matters on whom he can rely to superintend the business or the commercial aspects of his work. Such responsibilities should not necessarily involve the employment of an accountant trained to the professional level. Nor, indeed, would a professional accountant necessarily be the best person to employ in such a specialist position.

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[1] Report of the Third Commonwealth Education Conference, Annexe VI, paragraph 3.

Qualities Necessary in the Business Technician

10 Having discussed a definition of terms, the Group turned its attention to a consideration of the qualities needed in the person working at technician level in business.

11 Technician work involves an element of judgement and the intelligent application of knowledge derived from theoretical and practical training and experience. Emphasis must be placed on the value of qualities other than academic attainment, e.g. leadership, personality, initiative, imagination and the ability to communicate successfully.

12 The type of entrance qualification needed to embark upon a course of study at this level in commercial subjects was considered and examples were given from different countries of specific entry qualifications. But the importance of entrance qualifications should not be overstated, and a realistic route must be preserved for those who appear likely to complete the training successfully without necessarily possessing formal academic qualifications. Technician level courses should be terminal courses and designed as such. This should not, however, be taken to exclude the possibility of the technician being able to undertake additional study and training for professional work if he has the ability and desire to do so.

13 The Group paid particular attention to the position of women in business. All that may be said about education and training for business applies equally to women as to men. Large numbers of women throughout the world are employed in the sales forces and office staffs of business concerns, although mostly in subordinate posts. Some, however, rise to positions entailing technician responsibilities or even higher as a result of their experience or as a result of education and training. It was emphasised that the educational and training route into such technician posts as senior private secretaries, personal assistants, marketing and market research assistants (especially in the consumers' goods field), computer programmers, office supervisors, etc., should be open to women. They are often specially suited to undertake responsibilities at this level, being consumers themselves and having special experience in matters concerning consumers' goods.

14 As was pointed out in the Report of the Third Commonwealth Education Conference[1], while many women leave work fairly early in their careers in order to become married, a considerable proportion in the more developed countries return to part-time or full-time employment after raising their families. Indeed, this might well be the point at which suitable women should be admitted to technician education and training courses.

Types of Courses

15 The early stages of the education and training of business technicians should be fairly broadly based and involve some study of economics, quantitative subjects, the sociology of business, law, and communications. Emphasis must be placed on the importance of the study of the environment of commerce, which will include, in many countries, an appreciation of technological changes and developments.

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[1] Report of the Third Commonwealth Education Conference, Annexe VI, paragraph 29.

16 After this broad introduction the technician should go on to more specialised studies. In the United Kingdom the scheme for Ordinary and Higher National Certificates and Diplomas in Business Studies combines the breadth necessary in the early stages with the opportunity to specialise in the later stages. In addition, there are available a number of specialised qualifications in such fields as law, supervision, work study, etc. (see Appendix A). Other business technicians study for part or all of the professional or quasi-professional qualifications in such fields as accountancy, purchasing, marketing, banking and insurance. This method is much less satisfactory, as it carries the implication that a technician is a failed or incomplete professional person.

17 New Zealand educational authorities have recently given much attention to this problem and the outcome has been the inclusion of commercial studies in a scheme conducted by the Technicians Certification Authority of New Zealand. Appendix B gives details of this development. Commercial education in Australia, in common with the whole complex of tertiary technical education, has recently been reorganised to provide appropriate courses at all levels. This has been achieved as a result of co-operation between the technical college authorities and the professional associations.

18 In the developing countries technician education and training in business should be related to the needs of those countries and those countries should set up their own schemes of courses, training and examinations, being advised, if necessary, by countries where such schemes are already well established.

19 It is also necessary that in the developing countries men and women already in technician posts or capable of rising to them should have the opportunity of taking special courses or of entering normal courses, without necessarily having the prescribed basic educational qualifications. An example of such a scheme already under way in Uganda with ILO assistance is given in Appendix C.

20 There is a real need to have academic studies related to supervised practical training at least by the time specialisation began. Thus, in the British scheme, the Higher National Diploma course ought, whenever possible, be a three-year sandwich course. It is all too easy, as experience in some countries has already shown, for young men and women to learn about business without acquiring any of the business skills.

21 The Group gave attention to the question of the relationship of professional bodies to technician courses and qualifications. In several countries some quasi-professional bodies are concerned with technician level techniques and responsibilities but difficulties may arise with the genuinely professional body, and it was generally agreed to be preferable for these bodies to assist technician level associations without becoming responsible for qualifications or course requirements.

22 Consideration should be given to a diversification of the upper levels of secondary education, including the provision of pre-technician commercial courses as an option where this has not already been done. The route to technician level work in business should be possible via the educational and training ladder, rather than exclusively via the promotional ladder in the business world, and thus take account of social changes which result in a trend towards longer full-time education (including sandwich courses).

Aid to Developing Countries

23 The Working Group considered the question of the most appropriate form of aid which could be provided by the developed countries. Great emphasis was placed on the necessity for a survey of needs in the developing countries. The results of a manpower survey to assess the demand for technicians in any given country would provide the information really necessary for a realistic evaluation of the type of training necessary and the type of aid which would be of most value. Aid in the conducting of such a survey might be considered a priority.

24 The Working Group recommends:

(i) the extension of teacher training facilities in the developing countries in addition to the facilities already available in developed countries;

(ii) secondment, for short periods, of highly qualified experienced personnel from developed countries to help with subject tuition, organisation of courses and teacher training;

(iii) provision of tested correspondence courses already in use could be made more widely available. It was recognised that such courses would need to be adapted to local needs but provision of the basic courses would help to facilitate the lengthy process of writing appropriate correspondence courses.

25 There is much to be said for the direct 'institution to institution' method of aid, and for a scheme whereby a team of teachers from a college in a developed country spends some time at a college in a developing country. A relationship of this type between colleges could result, to their mutual benefit, in an exchange of staff, research assistants, students, and ancillary staff such as librarians. The colleges could remain in continuous touch for the exchange of ideas and information in the fields in which they have mutual interests.

APPENDIX A

List of Some Specialist Technician Qualifications in Business Studies in Britain

(*a*) *Technician or primarily technician associations*

  (i) The Qualified Private Secretaries' Association Ltd.
  (ii) The Institute of Legal Executives
  (iii) Institute of Commercial and Technical Representatives
  (iv) The Institute of Linguists (insofar as they concern people in the business world)

(*b*) *Technician qualifications provided by mainly professional bodies*

  (i) Graduateship of the Institute of Transport
  (ii) (*a*) Certificate in Office Supervision and
    (*b*) Diploma in Organisation and Methods of The Institute of Office Management.

(*c*) *Technician qualifications offered by Examining Bodies*

  (i) Specialist examinations conducted by The Royal Society of Arts
  (ii) Specialist examinations conducted by The London Chamber of Commerce
  (iii) City and Guilds of London Institute's Certificate (*a*) for Computer Personnel and (*b*) in Retail Management Principles.

APPENDIX B

New Zealand Experiment in a Technician Course for Commerce

I. *The New Zealand Certificate in Commerce*

Reference to the early stages of development of the New Zealand Certificate in Commerce is made in a background paper prepared for this Conference.[1] The proposed national conference on technician training in Commerce mentioned in this paper was held in August 1966. Enthusiastic support for the proposed Certificate was promised from national bodies such as the New Zealand Society of Accountants (indisputably the senior professional body in the commercial field), the New Zealand Manufacturers' Federation, the Associated Chambers of Commerce, the New Zealand Retailers' Federation, the New Zealand Law Society, and the States Services Commission. The following bodies were more cautious in giving support as the adoption of the New Zealand Certificate as a specialist qualification would mean the abandonment or drastic modification of existing specialist courses and examinations:

The New Zealand Bankers' Institute
The New Zealand Insurance Institute
The New Zealand Municipal Bodies Association
The New Zealand Institute of Management

The response at the August Conference was such that the Minister of Education has invited the New Zealand Technicians Certification Authority, a statutory body already promulgating technician courses and examining in the fields of Building, Engineering and Science to establish an Executive Committee for Commerce.

This Executive Committee is now being appointed. On it, some of the major occupational groups listed above will be represented together with a minority group of educationalists and educational administrators. The Committee will be given the task of drawing up a five year part-time course—approximately 1300 hours of tuition. It is likely to have the following features:

(i) It will be a national course offered by all Technical Institutes in New Zealand with the Technical Correspondence Institute taking care of students who, because of distance or nature of employment, cannot attend 'live courses'. Details are given in a background paper prepared for this Conference.[2]

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[1] Paper C.E.T.T.(P) 2/8, pages 16 and 17. (See Appendix II).

[2] Paper C.E.T.T. (P) 2/2. (See Appendix II).

(ii) The New Zealand Certificate in Commerce will be equated in terms of academic depth with the existing New Zealand Certificates in Building, Science and Engineering. It is safe to assume that students who pass the New Zealand Certificate in Commerce *with* outstanding merit and wish to proceed to university degrees in Commerce or Business Administration will be given substantial credits.

(iii) Students will not be permitted to proceed beyond year *two* of the five year course unless they are 'suitably employed'.

(iv) Credits for appropriate subjects passed in the School Certificate examination will be given for subjects in year one; credits for appropriate subjects passed in the University Entrance examination will be given for subjects in year two. Credits for partial passes in professional examinations (e.g. New Zealand Society of Accountants) may also be given for equivalent subjects in year three. It is unlikely that any exemptions will be given for subjects in years four or five.

II. *The Framework of the Certificate*

(This has been a talking-point in negotiations with the bodies consulted. The Executive Committee for Commerce now being set up by the Technician Certification Authority may alter this drastically.)

Year One

Communication English (Part of all New Zealand Certificates for Technicians —no exemptions given for passes in English in any examination)
Accounting Techniques I
Mathematics I
Geography

Year Two

Statistics and Presentation of Data
Accounting Techniques II
New Zealand History (Social, Economic, Political)
Technology for Commerce

Year Three (common to all options)

Principles of Law
Accounting Techniques III (for those 'majoring' in Accountancy), or
Accounting for Control
Business Economics
Commercial Sociology

Years Four and Five

Two years of specialisation in *one* of the following *options:*

(1) Accountancy
  (*a*) private sector
  (*b*) public sector including
    (i) local bodies such as Hospital Boards and City Councils
    (ii) Government Departments

(2) Merchandising (wholesale and retail)
(3) Costing
(4) Computer Programming
(5) Insurance
(6) Banking
(7) Taxation
(8) Customs Procedure
(9) Transport
(10) Real Estate
(11) Legal Executive

A student who qualified would indicate that he held, say, the New Zealand Certificate in Commerce (Banking) or the New Zealand Certificate in Commerce (Merchandising).

III. *Examples of 'Commerce Technician' Work Situations*

Note: The following correspond to the numbered options given in II above.

(1) *Accountancy*
  (*a*) Private Sector
    (i) Senior clerk in a firm of accountants involved in public practice
    (ii) 'the accountant' of a typical New Zealand merchandising or industrial unit of small or medium size
  (*b*) Public Sector
    (i) A sub-accountant in a Government department
    (ii) Accountant to a local body other than a large municipality which would probably appoint a professional accountant as a treasurer.

(2) *Merchandising*
  A Branch Manager of a large departmental store, e.g. Woolworths

(3) *Cost Accountant* responsible for providing all data for Budgetary Control and Pricing

(4) *Computer Programming*
  A programmer but *not* a system analyst

(5) *Insurance*
  Any executive position (other than actuarial) in a branch insurance office

(6) *Banking*
  Any position up to Branch Manager

(7) *Taxation*
  (i) An inspector for the Inland Revenue Department
  (ii) A specialist in taxation for a large commercial unit working under a professional accountant

(8) *Customs*
  (i) An inspector for the Customs Department
  (ii) An executive of a Customs Agent (private sector)
  (iii) A specialist in customs procedure and import licensing for an Importing Firm

(9) *Transport*

An accountant or assistant manager for a large transport firm (shipping, road or air)

(10) *Real Estate*

Management, sub-management with emphasis on valuation

(11) *Legal Executives*

Senior clerks (but not partners) in legal firms

IV. The Appeal of the Certificate

(1) To the New Zealand Society of Accountants:

(*a*) A supplementary scheme to permit:

(i) the up-grading of Professional Accountancy Examinations

(ii) the reduction of the ratio of Professional Accountants to the community
as a whole, e.g. New Zealand 1 : 300 approximately
United Kingdom 1 : 900 approximately

(*b*) A source of trained 'middle-group' personnel to whom non-professional work can be delegated.

(2) To Employers:

A specialist qualification that suits their varied needs.

(3) To Students:

To postpone irrevocable decisions about careers until basic commercial training has been given.

(4) To Teaching Institutions:

(*a*) The rationalisation of an untidy field of training;

(*b*) Elimination (in time) of a system whereby they must prepare students for a multitude of examinations where basic content is similar but early specialisation means the proliferation of elementary classes into uneconomic groups.

V. Difficulties to be faced

(1) The possible competition from examination systems and courses already firmly entrenched, e.g. Chartered Institute of Secretaries, New Zealand Institute of Management.

(2) The acceptance by parents, adolescents and school careers advisers of terminal, sub-professional qualifications.

Notes

1. This difficulty has been largely overcome in Engineering, Building and Science. Presumably there will be the same acceptance in commerce, particularly as the failure rate in professional courses is extremely high.
2. The probable establishment of a link between technician certificates and University degrees (see I(ii)) will assist here.

APPENDIX C

A Scheme for the Training of Finance Officers in Uganda

As in many developing countries, Uganda has an urgent need for trained finance officers in its local administration services. The ILO agreed to assist the Uganda Ministry of Regional Administration to undertake this training. A small team of experts was provided and they studied the work of local finance officers before drawing up syllabuses including those dealing with background subjects such as the economics of developing countries. They then wrote correspondence courses to meet these syllabuses, and designed the course in three stages, each requiring approximately one year of part-time home study supplemented by local tutorial group meetings at intervals whenever these could be arranged. An examination is prescribed for the end of each of the three stages.

No formal educational qualifications are laid down for enrolment to the course which is open to anyone working in the finance departments of the local administration. The demand for the course has been heavy and only three hundred and fifty students are accepted at any one time. Students who fail to send in work reasonably on time are ruthlessly removed from the course to make way for applicants on the waiting list.

The project has been so successful to date that it is being adapted to provide courses for similar staff in other organisations such as hospital finance officers.

Discussion of Report in Plenary Session

The Chairman of the Working Group introduced the report by drawing particular attention to the effort that had been made to define the 'business technician'. In designing courses for such people flexibility must be the keynote with emphasis on the need for studies to be very broad based at least in the initial stages. The importance of personal qualities in the field of business and commerce was stressed.

Attention was drawn to the London Chamber of Commerce and Royal Society of Arts joint scheme for an overseas Ordinary Certificate in business and commercial studies, with special options. This is a full-time course. A Higher Certificate in this field is also in prospect. The devolution of examining functions to local bodies, such as is now taking place in Nigeria, was seen to be a likely development elsewhere.

There was a measure of disagreement on the value of short periods of secondment of the type recommended in the report. It was suggested that these are not always of great value, and there was general agreement that very careful planning is needed in this connection.

Reference was made to the need in overseas countries for women to be trained in order to play their part in fulfilling the general need for personnel. The particular need for, and place of, women in the field of business and commerce was stressed.

Report of Working Group B(4)

CHEMICAL AND OTHER SCIENCE TECHNICIANS

Chairman: Mr. B. H. Henson (Britain)

Introduction

1 The Group identified two main categories of science-based technicians:

(*a*) 'Laboratory' technicians e.g. those engaged on routine laboratory work either in educational establishments or industry, specialised occupations such as glass working, medical auxiliaries who use a very restricted range of techniques.

(*b*) 'Science' technicians e.g. technicians in the chemical, metallurgical, petroleum industries. The essential role of science technicians is to work under the direction of a technologist in research, development, process or quality control. They will not be engaged on routine work which can be done by a laboratory technician and in many cases their contribution to a development project can be of near-professional level. Their place in the science-based industries ranges from quality control through sales and technical service to research.

2 While it is recognised that there are technicians who cannot easily be placed in either of these categories, the Group confined itself to a study of the courses of education and training which are provided, or should be provided, for laboratory technicians and science technicians, with particular reference to the needs of developing countries. The study included:

(*a*) Types of courses;

(*b*) Accommodation and equipment;

(*c*) Staffing;

(*d*) Assessment.

3 It should be noted that women are particularly useful in meeting a country's needs for science-based technicians and in this paper references to technicians should be taken to apply, without exception, to both women and men.

'Laboratory' technicians

4 There is a relatively extensive provision of facilities for the education and training of laboratory technicians, much of it being along the lines of the recently revised City and Guilds Course 119. Since there is a severe shortage of medical laboratory staff at this level, it would be advisable for countries to include, if possible, 'Medical Laboratory Techniques' as one of the options. This would provide a source of technicians capable of doing routine preparations and tests as well as servicing medical laboratories and their equipment.

'Science' Technicians

Industrial Requirements

5 In countries where science-based industries have recently been established or are as yet in an 'embryo' stage, the essential need is to provide a population of technicians who are adaptable to new industries. A man must be able to leave his job as a textile-chemistry technician to take up a job in a newly established food processing plant. To meet this situation it is essential to avoid too-early specialisation in a particular set of techniques. The objective should be to provide a course which is sufficiently broad-based to equip the technician for change, while at the same time offering a sufficient degree of specialisation to enable him to make an immediate contribution to industrial productivity.

6 Since facilities for on-the-job training may not always be available, courses for science technicians should, in general, be full-time, although for certain categories of specialist technicians a sandwich course may be appropriate.

A Possible Curriculum for Science Technicians

7 A two-year technician course will provide for the essential basic scientific requirements and permit a degree of specialisation sufficient to enable the student, upon completion of the course, to perform a useful and worthwhile job in any one of a number of industries.

8 Such a course will require a sound foundation of science and mathematics, and might also lead to specialist third-year courses as appropriate. Entry to the basic technician course should require a secondary education during which mathematics, physics and either chemistry or biology have been taken to the equivalent of GCE 'O' level standard with success in a minimum of two of these subjects.

9 Provision should be made for experienced laboratory technicians, who may have entered industry without completing a secondary school course, to enter the technician course.

10 Where there is a lack of qualified secondary-school leavers a pre-technician course will be required. This should follow the pattern of the first year of the technician course but at a lower level. The main aim of this course is to remedy the deficiencies in mathematics and science with the additional object of ensuring practical ability in the laboratory before joining the technician course.

11 *First Year.* While it would be very desirable to have a detailed 'job analysis' of the various technician occupations, certain aspects of science can be recognised as fundamental to the education of the technicians being considered. Mathematics is the tool of the science technician, no matter what his final occupation, so it must be studied beyond the secondary-school level. The physical sciences of chemistry and physics touch on the work of so many technicians that they too should be pursued beyond the level of the full secondary course. The increasing importance of occupations based on biology makes it imperative to include biology in a basic course for all science technicians. (It would indeed be desirable for all technicians, no matter what their discipline, to study biology

for its wider effect on social and personal health.) It should be emphasised that only if biology is taught from the standpoint of an experimental, quantitative science can its inclusion in this course be justified.

12 Working under the direction of a technologist, the technician's job is of a practical nature. It is for this reason that practical work must constitute a large proportion of the course. He must have a sound familiarity with a wide range of laboratory techniques. This practical emphasis should also appear in the mathematics course and it is essential that 'formal' mathematics be reinforced with practical exercises on statistics, desk calculators and an introduction to computer technology.

13 In the absence of 'apprenticeship' in an industry, the college course must include laboratory 'crafts' where ancillary techniques (e.g. glass-working, engineering drawing) and simple mechanical skills (e.g. soldering) can be acquired. In this element of the course can be included industrial safety (laboratory safety would be included in the laboratory procedures course) and first-aid.

14 While the science technician may work with machines he must still communicate with his fellow workers in spoken and written language. If the language of industry is English, then English should also be treated as a technical subject. General Studies, as distinct from English, has a place in the curriculum if it is accepted that the college has a responsibility to equip the student for life outside the laboratory or plant, though some time should be allocated to an industrial orientation course e.g. industry's contribution to the economy, the employer/employee relationship, industrial finance.

15 *Second Year.* A two-year full-time post-secondary course will provide sufficient training and education for a wide variety of posts only if the second year of the course can offer a sufficient degree of specialisation to make students versatile and valuable to a number of industries. It is suggested, therefore, that besides a continuing study of mathematics, physics, laboratory crafts, English and general studies, students should be able to choose one major area for specialist study.

16 Three such major areas might be:

(i) Chemical Area; e.g. organic chemistry, chemical process graphics, introduction to unit operations, physical chemistry, instrumental methods of analysis.

(ii) Biological Area; e.g. microbiology, biochemistry.

(iii) Physical Area; e.g. optics, measurement, nuclear power.

17 In each of these major areas a number of different subjects will be provided and students should select from one or more of the major areas such combination of subjects as will best meet their specific specialist requirements.

18 All subjects in the second-year course should retain the strong practical/ laboratory bias.

Structure of 'Basic' Course

19 The two-year course might be organised as follows:

First Year:	Chemistry theory and practical		200 hours
	Physics theory and practical		200 hours
	Mathematics theory and practical		200 hours
	Biology theory and practical		200 hours
	English and General Studies		100 hours
	Laboratory Crafts		100 hours
		Total	1,000 hours
Second Year:	Mathematics theory and practical		150 hours
	Physics theory and practical		150 hours
	English and General Studies		100 hours
	Laboratory Crafts		100 hours
	Chemical Area or Biological Area or Physical Area	selection of subjects to a total of	500 hours
		Total	1,000 hours

Note: In both years it is recommended that at least fifty per-cent of the time available for technical subjects be devoted to practical/laboratory work.

20 *Third-Year Specialist Studies.* For many students, the two-year basic course and qualification will be terminal and the proposed scheme will provide a supply of technicians capable of making an effective contribution to meeting industrial and other requirements. It was considered, however, that an additional course of one year's duration ought to be planned so as to cater for a higher degree of specialisation where this is required. Examples of such additional specialist applications would be textile technology, plastics technology, metallurgy, food processing, petroleum technology, instrumental methods of control, data-processing, para-medical studies, health physics, nuclear physics. English and general studies would still be required and an increasingly important element in this course should be industrial organisation, i.e. industrial organisation and administration, including a consideration of inter-personal relationships in industry. While this would not be a management course, it is important to give the young technician an opportunity to examine his role in industry and to view his industry as a whole.

21 These specialised courses, and ad hoc courses of shorter duration, should be determined by local needs. In some instances students may proceed directly from the basic course, whereas in others the course may be required to provide additional specialisation for technicians who have been in industry for some time.

Structure and Organisation of Third-Year Course

22 For industrially-orientated specialisations e.g. instrumental methods of control, chemical process engineering, a sandwich course may be more suitable

than a one-year full-time course: the pattern could be six months in college, six months in industry, six months in college. This course could be organised to include a reasonable amount of project work on the part of the students, and in some cases a minor thesis would be appropriate, covering either practical project work or a survey of technical literature. Use of the library and the principles of data research should be taught.

Staffing

23 It is essential for teachers of these courses to have extensive industrial experience. Part-time teachers from industry or government who have taken a short course of teacher-training can make a very considerable contribution to the specialist courses.

Accommodation and Equipment

24 *Accommodation.* In the same way as the science technician needs to be educated for change so the buildings where he studies must themselves be capable of change. A flexible design of laboratories will enable them to be modified as the need arises e.g. every laboratory should have an adequate supply of power points and other services whether or not it is initially intended as an organic laboratory or a physical chemistry laboratory.

25 *Equipment.* For certain specialist courses the possibility of utilising appropriate equipment in local laboratories and industry should be investigated. For economic reasons a complete chemical pilot-plant is not feasible in a college with few students studying unit operations but such plant might be accessible in the vicinity. It is important that the educational value of the outside facilities be thoroughly appraised. The needs of an industrial laboratory are not necessarily identical with those of a college. Whether or not the equipment is useful for teaching should be decided by how much the students will learn from it. The teacher must make this judgement. College equipment should be purchased using the same criterion—'Is this the best piece of apparatus available for *teaching* purposes?'. The refined Mark V model might have fewer controls and operate three times as quickly as the earlier Mark II model, but the student might learn much more of the principles of operation and reasons for maintenance procedures from the Mark II.

26 *Text-books.* The growth in new science technician courses in recent years has outstripped the provision of suitable text-books. Text-books appropriate for science technician courses should be made available as soon as possible. It is hoped that as these courses develop so the teachers themselves will be encouraged to write suitable text-books based on their own teaching experience. Some facilities are available to assist teachers in this work but there is a need for co-ordination of these efforts.

27 *Assessment.* In view of the world-wide research projects and investigations into methods of assessment it would be premature to recommend any particular assessment procedures. If courses for science technicians are instituted they will provide teachers and examining bodies with an opportunity to evaluate different types of assessment procedure which are of proven validity e.g. 'open-book' examinations, continuous assessment of practical work, project work.

Conclusion

28 Note must be taken of the growing economic importance of the science-based industries in every country of the world. Fundamental changes are taking place in the laboratory and in plant with the rapidly increasing use of instrumental methods of analyses and automated process control. All these trends point to a need for a corps of technicians whose education enables them not only to take a pride in the job and to recognise the contribution which they make to industry, but also prepares them to cope with innovations in technology and administration. They must have a training which will enable them both to work efficiently on an assignment and to analyse problems in a rational and scientific manner. Even from these initial steps in the analysis of a technician's job it is obvious that much of the work done in developed countries by professional grades could be done by technicians.

29 Technologists trained at great expense to the community should be deployed in such a manner that the maximum number of technicians are productively employed. Technicians and technologists are complementary in an industrial society: this should be reflected in the salary scales of science technicians.

Discussion of Report in Plenary Session

The Chairman of the Working Group explained that two categories of science based technicians had been identified. Particular concentration had been placed on the consideration of a two-year full time course for 'science' technicians, to be followed by a third year of specialist studies. The need for appropriate equipment in such a course was stressed, and particular attention had been paid to this point.

The proposed course structure contained in the report was commended, as was the reference to the role of women in this field.

Report of Working Group B(5)

CIVIL ENGINEERING AND CONSTRUCTION TECHNICIANS

Chairman: Mr. G. Stoker (Australia)

Introduction

1 The task of the Working Group was to consider the education and training of civil engineering and building technicians. There is felt to be some lack of precision attached to the terms 'civil engineering', 'construction' and 'building' and for the sake of clarity the term 'construction' is used in this report to denote the activities normally included under the terms 'building' and 'civil engineering'. Where it is necessary to make a distinction between these fields, the latter terms are used. It is considered that the needs of the technician on both the contracting and design side are basically the same. These definitions, it is realised, do extend somewhat the normal sense of the word 'construction' but it is felt to be desirable to do so.

2 Some little time was spent on a brief survey of the needs and conditions, and the courses available in the various countries represented. There was noted a distinction between the developing countries on the one hand and the highly industrialised countries on the other. In the former, education and training has to take place against a background of little tradition of technical skill, and, in some cases at least, of very few enterprises in which practical training can be given. The educational system, also, tends to be orientated towards classical, non-technical subjects, although in some countries this deficiency is being corrected by the introduction of technical subjects in the school curriculum. Courses in such countries, therefore, have to provide, as far as possible, for both the technical education and the practical training of the young technician. The general pattern tends to be one of full-time courses, normally extending over at least two years for the majority of students, with provision for further courses for the more outstanding. In the more developed countries much of the training, as opposed to the education, is carried out in industrial situations, and colleges concentrate on the educational side. Hence in such countries various forms of part-time courses, such as day-release, block-release and sandwich courses are found to be suitable and possible.

3 In all countries there is a need for basic general technicians and for more specialised technicians. Particularly in the construction field, the need is greatest for basic courses. Practically all young men entering the industry should be first given a general education and training in construction: this should cover subjects such as Constructional Practice, Science, Technology, Mathematics, Technical Drawing, Surveying, and Communication Skills. It is felt, however, that a completely common course between building and civil engineering cannot be maintained much beyond the end of the first year, after which some divergence appears inevitable. In the developing countries existing courses such as those

leading to the award by the City and Guilds of London Institute of Ordinary and Higher Technician Diplomas, appear to furnish a suitable framework within which studies for more specialised subjects may be developed to meet each country's needs as required.

4 The need for more specialised training at a higher level could be satisfied either by organising the necessary courses locally, or, if the numbers required were not sufficiently great, by sending suitable men for training at centres in other countries.

Construction Technician Training

5 *Entrance Qualifications.* There are three generally accepted categories of recruitment:

(i) School leavers at the age of sixteen who have successfully completed a secondary school education.

(ii) Craft apprentices who have attained a recognised qualification in their particular craft.

(iii) Mature students who, by the nature of their employment, require a technician course of study.

6 *General Outline of Course Structure.* The construction technician specialises in areas of work, such as production planning, quality control, surveying and measuring, site organisation and management, and specialist building services. Courses need to cater for this diversity.

7 A two-year broadly based course of study, which may be followed by further end-on specialist training directly relating to the industrial needs of the country, is recommended. This pattern should be followed on a full-time or part-time basis depending on the stage of development and the location of the industry. In general a 40 per cent practical content is considered desirable during the first year followed by a 50 per cent practical content in the second year. This practical work should include a sound appreciation of the skills and practices of construction. The course of study should be designed to encourage individual student activity using project and other practical work as an essential element in the students' training. All technician training should be organised to encourage the development of individual initiative and responsibility in the trainees. The practical training in the technician course includes both practical work within the college and the follow-up training in industry.

8 For developing countries, two main courses will provide for two categories of technician: a two-year basic course, in itself terminal and complete, which will satisfy the requirements for a wide range of technician activities; a further two-year course which will provide for more advanced specialist training.

9 These courses should be available on either a full-time or a sandwich basis: the latter type are desirable if they can be arranged, but the problems of providing planned industrial experience and co-ordinating this with the educational course are more severe in developing countries. Part-time day-release courses are considered a most valuable form of training and education where industry is in close proximity to the educational institution.

10 Close liaison with industry is the key issue in planning either the end-on practical training, or a sandwich course arranged under the control and guidance of an industrial liaison officer. A planned programme of practical work followed by some supervision or inspection is essential to all technician training. This work experience should be recorded and assessed by the industry's training authorities; local needs would dictate the specialist practical content.

11 Recognition at the two levels of training by certification should be given, with the final certification being given after appropriate industrial experience.

Status of the Construction Technician

12 The place of technicians in the construction industry covers such a wide field and diversity of activity that any generalisation is likely to lead to confusion. It is evident, however, that many countries experience difficulties in recruiting the right type of personnel to the industry and the right kind of students to courses.

13 Governments should lead in providing training developments and enhancing the status of technicians. Construction technicians, no less than other mortals, are likely to be attracted by good salary or wages, security and prospects for advancement to more responsible work.

14 Use should be made of the considerable scope for development of and for the individual within the wide range of technician employment offered by the construction industry.

15 Real knowledge of the sectors of industry under consideration and a thorough appreciation of personnel, technical and psychological issues involved, is required on the part of authorities concerned with planning technician development for construction. Specialists in the various fields should be consulted. It is likely that where industry is consulted, not only will the problems of provision of adequate industrial experience for students be solved, but there will also develop within industry a healthy interest and respect for what technical education has to offer in the provision of technicians. The construction industry in all countries must bear the major part of the responsibility for ensuring that its own technician force is adequate in numbers, education and training and is provided with the means of keeping itself up-to-date by refresher visits, conferences and courses in the essential specialist fields of work.

16 The Group makes the following recommendations:

(*a*) Entry requirements to courses must be flexible.

(*b*) Practical subjects should be introduced in the secondary schools in order to orientate pupils towards technician training. For this purpose it is essential that there should be liasion between the secondary and further education authorities.

(*c*) Recruitment of the technician must take cognisance of long-term work prospects and reward.

(*d*) Specialist courses should be offered in countries where facilities and equipment are available. A 'Clearing House' which would act as an agency at national and international level is essential for providing courses on an economic basis.

(*e*) Close liaison with industry in the planning and supervising of industrial training is an essential ingredient in all technician training.

(*f*) A teaching approach which will encourage and recognise a student's personal initiative and ability should be encouraged at all levels.

(*g*) Assessment and certification of the technician student's technical course and industrial training should be carried out by both educationalists and industrialists in joint consultation.

(*h*) The construction industry in each country should be encouraged by government to accept a major responsibility for initiating the training schemes for technicians.

Discussion of Report in Plenary Session

The report was introduced by the Chairman of the Working Group who pointed out that a lack of precision in the term 'construction' had caused some difficulty. It was not thought possible to envisage a common course for all the technicians concerned, except perhaps for the first year. Courses should contain a high proportion of practical work, and close liaison should be maintained with industry. Certification should certainly be provided, but no suggestion was made as to who should provide it. Courses devised for other countries should not be imported *en bloc* into developing countries, but only used as guides.

A number of delegates expressed preference for the retention of the term 'civil engineering' and it was suggested that Materials Science should be included as an essential subject in these technician courses.

The need for flexibility in the provision of training was stressed.

Particular attention was drawn to the need to train architects' assistants. It was pointed out that the problem raised by the gap between the language spoken by the architect and that spoken by the builder has only recently been faced in Britain. There is now a National Certificate in Building with endorsement in architectural subjects. In Britain a gradual breakdown is taking place of the barrier between the architectural and the building functions; this is exemplified by the development of consortia. Although lack of co-operation cannot be justified, some splintering between the design and building functions may be inevitable. The construction technician required academic qualifications plus practical competence, and a degree of specialisation was desirable at the higher level.

Report of Working Group B(6)

TECHNICIAN EDUCATION AND TRAINING OF SPECIAL INTEREST TO WOMEN AND GIRLS

Chairman: Miss E. L. Young (Britain)

Introduction

1 If the supply of trained people is to match the needs of a community, use must be made of women as well as men. In the past girls may not always have had sufficient education to secure entry to training but the number of girls with a secondary education is steadily rising in all countries, although the choice of subjects in schools may sometimes be unduly restrictive. Obsolete methods of housekeeping and farming make inordinate demands on the time and energies of women but technical progress should free them from much of the drudgery, particularly if attention is directed to the design and production of simple and cheap labour-saving devices, Specific recognition should, therefore, be given to the fact that women have a part to play in a developing economy and that they can make a particular contribution at technician level. It follows that, in vocational guidance, information about all opportunities of employment should be given to girls as well as boys and the general public made aware that these opportunities are available to both sexes. Industry, too, should direct its recruiting efforts at both girls and boys.

Fields of special interest to women

2 In fields such as nursing and teaching, women have no difficulty in securing entry. In industry, however, there may be, for a variety of reasons, a distinction between men's and women's work. That this may be independent of the nature of the work is shown where men's work in one country is women's work in another. Revolutions in technology and methods of production are eliminating many of these distinctions. It may take time to overcome existing prejudices but fortunately these do not exist in all countries. Women should be able to enter technician training on precisely the same conditions as men, and should be given encouragement to do so. Selection of entrants should be based on inclination, aptitude and ability; applicants should not be rejected, as still sometimes happens, solely on account of sex. Where unemployment is rife and men are breadwinners for their families, they have special claims to training places, but it is not a sound policy to debar all able women until the least able of the men has been trained since development depends on the quality of the contribution made by the individual.

3 In commerce, both women and men are needed to relieve manpower shortages, particularly of secretaries. There is a rising demand for technicians in management, marketing and retail distribution. A member of a small co-operative who is concerned with organisation, marketing and keeping of accounts, would benefit from the training which a technician could give.

4 Catering and food technology are expanding rapidly, and as a consequence so too are the demands for personnel in a variety of technician grades. Catering technicians are needed because of the increasing numbers of hospitals, school and college hostels, works and office canteens, and it is desirable that these technicians should be trained in their own country using their own raw materials. There is also a demand for technicians in hotels and restaurants, especially where tourism is an important factor in the economy. In food processing, one of the ways in which women can make a special contribution is in teaching methods of food preservation and marketing to women in rural areas.

5 In the agricultural and horticultural extension services, women already play an important part in many countries, and their services are particularly valuable where most of the work on the land is undertaken by women.

6 Women are employed in many of the services ancillary to medicine, e.g., as radiographers and laboratory technicians; girls should be told of the opportunities in these services as well as of those in nursing. Para-medical technicians often take charge of small village hospitals and here women technicians can make a special contribution. In all countries there is a demand for nursery nurses, but where training facilities are limited or non-existent this demand cannot be satisfied.

7 In the efforts to raise standards of nutrition and hygiene, women technicians in home economics can do much to help women in villages and towns. Home economists are particularly useful in journalism and television for keeping women abreast of modern developments. Technicians in public health help to improve conditions in streets and market places. Women have a part to play in community development by informal as well as formal teaching in such matters as sanitation, and the protection of water supply and food.

8 Women have a special interest in all matters affecting houses, including structure, furnishing and equipment. Functional efficiency may be achieved more readily if women are available at technician as well as at craft and professional levels in architecture, applied art and equipment design.

9 Cottage and homecraft industries have special advantages for women and, in rural areas, for men too because the nature of the work is such that it can be fitted into the pattern of other work in the home and on the farm. Industrialisation may sweep away many of these industries, but industrialisation takes both money and time. National planning will indicate which cottage industries are likely to exist long enough to make training worth while. Sometimes it may be advantageous to mechanise part of the cottage industry, the part that is least profitable to the worker. For example, cotton ginning and cotton spinning should be mechanised because hand methods are unsatisfactory and take too much time, but handloom weaving can profitably be continued. Many of the people working at craft level in cottage industries use inefficient techniques and there is need for women and men to be trained as technicians to act as intermediaries between the technologist and the craft worker; to teach better techniques, and the use of new tools, labour-saving devices and, where appropriate, small power units; and above all to raise and maintain standards of quality and design. Where these standards are high, the goods produced find a place in the export market and also provide a further source of income from tourism. Training for

home industries has already started in a number of countries. Mobile training units are valuable in enabling technicians to cover a wide area. There is need also for technicians in commercial skills to organise the buying of raw materials, the marketing of finished products and to encourage the formation of co-operatives by training a selected member to undertake these duties. Without some form of co-operative organisation it is difficult to protect the craftworker against exploitation.

Conclusion

10 To sum up, girls should be actively encouraged to undertake technician training and should be made aware of the full range of opportunities through an organised vocational-guidance service. No concessions are necessary or desirable in entrance qualifications or in standards of attainment. All technician training should be open to girls as well as boys and selection or rejection of an applicant should be determined by inclination, aptitude and ability and not by sex.

Discussion of Report in Plenary Session

The report of the Working Group was introduced by the Chairman who drew attention to the need for vocational guidance for girls as well as boys. Specific jobs should not be regarded as being for men only or for women only; there are some areas in which women are already involved, and there are others in which they have a special role to play. Special qualities can be brought to bear by women in such fields as food technology and catering, medical ancillary work, nutrition and hygiene, housing (equipment, design etc).

In cottage and housecraft industries where extension work by technicians is very valuable, and in the co-operative field, technicians are needed to organise and help run the activities: in this field women can play a particularly useful role.

Reference was made to the difficulty of persuading industry of the usefulness of women. It was stressed that no concessions are needed by women for entry into technician education. The normal processes of selection should be used so as to select the best people irrespective of sex.

One of the problems mentioned was that girls tend not to stay on in the educational system for higher education and training, and are reluctant to go away from home for further training. It was pointed out that there is value in some form of technical training for a woman whatever the role in life she may undertake.

Particular mention was made of the importance of medical technicians, especially in developing countries. This was an occupation admirably suited to women, but the Conference had not really considered the training and education requirements for this type of technician although reference was made to the medical technician optional subject in the British Ordinary National Certificate in Science and to the qualifications of the Institute of Medical Laboratory Technicians.

Part III

CHAPTER XI

Assessment of the Present and Planned Provision for the Education and Training of Technicians in Commonwealth Countries

Lead paper presented by Mr. J. C. Jones, CBE, Adviser on Technical Education, Ministry of Overseas Development, London, England.

Introduction

1 The purpose of the present paper is to summarise and comment upon the information received from twenty-three of the countries participating in the Conference.[1] Further replies to the submitted questionnaire are expected (notably from India[2] and the UK) but it is regretted that they will be too late for inclusion in this paper.

2 Certain other difficulties arise in the presentation of this paper since not all replies conform to the pattern which was circulated, not all are able to give the statistical information required, and not all have placed the same interpretation upon the questions asked. When, in addition, note is taken of the wide range of economic and social development covered by the several Commonwealth countries, it is clear that any attempt to present assessment and conclusions within a single containing framework must necessarily fail.

3 Where possible, Tables have been prepared (see Appendix B) in support of the paper which, for the reasons stated, must take the form of somewhat disjointed comment following the pattern set by the questionnaire.

Section I

(a) *Population and Employment*

4 Table I shows population figures ranging from the 24 thousand people of Gibraltar to the near 56 millions of Nigeria. Were this ratio not of itself sufficient, it is likely to be multiplied eight-fold when the data from India are finally made available.

5 Similarly, active employment varies from 62·5 per cent of the population for Gibraltar to 3·2 per cent for the Gambia and 4·3 per cent for Malawi. There are, of course, special circumstances relating to these extremes and some possibility of different bases of computation among them but the range shown by the remaining countries (15 per cent to 54 per cent) is still sufficiently wide to justify your consideration of the factors involved.

6 Australia and the Bahamas have proceeded beyond the request in giving figures of both men and women in employment, an increasingly common feature in the more industrialised countries. In the UK, a little less than one-half of the population is actively employed representing approximately 64 per cent and 32 per cent of the male and female populations, respectively.

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[1] A copy of the questionnaire is attached at Appendix A.

[2] The data concerning India is given in the Appendix to Mr. Chandrakant's paper (see Chapter IV).

7 In using Table I it should be noted that census population figures relating to the early sixties have generally been employed in order that the ratios of employment could be determined. Estimates of present population, generally unaccompanied by employment figures, may show considerable increases over the first column of the table. It should also be noted that the minimum age for inclusion in employed figures varied between 14 years and 18 years.

(b) *Major Industries*

8 Whatever the nature of the reply concerning the use of the ILO classification of occupations, uniformity is not evidenced with respect to this section of the questionnaire and little purpose can be served in attempting a summary. Instead, Table II offers a number of specific examples selected from (a) predominantly agricultural and (b) predominantly industrialised countries.

9 It is abundantly clear from the examples chosen that not only does industrialisation call for increased technician training in its own right but that the demand is further increased by the need for technicians in the expanded supporting services, which are shown to average 61·7 per cent of the working population in an industrialised nation as contrasted with the 41·7 per cent of one which is predominantly agricultural.

(c) *High-level Manpower*

10 Table III shows a variation in the assessment of high-level manpower employment from less than 0·1 per cent to 8·1 per cent of the working population, a range which must be treated with some caution in the light of the equally large differences of interpretation placed upon the term 'high-level manpower' despite the guide lines laid down in the questionnaire. It must be said, however, that differences of interpretation exist even among the most highly developed countries including those where a university education is a common possession of persons engaged in high-level occupations: the position in the developing countries is obviously much more difficult to assess.

11 The majority of the participating countries shown in Table III, and particularly those more highly developed industrially, have been reticent on the subject of anticipated increases in high-level manpower. This defection on the part of the more developed countries is to be regretted in view of the lead which could have been given to others concerning the impact of technological advance upon the employment structure, but the difficulties of evaluating this impact, together with the effects of many other social, economic, and political factors, cannot be overlooked.

12 Few replies offer a breakdown of high-level employment and even these are varied in their form and content. Selected examples are given in Tables IVA and IVB.

Middle-level (Technician) Manpower

13 Table V similarly shows a wide variation in assessment (from 0·3 per cent to 11·7 per cent of the working population), the result in some cases of an equally wide range of interpretation of the term middle-level manpower. In one extreme case, omitted from the table, the figure for high-level employment was ten times greater than that for the middle-level, due to the exclusion from the latter of all but engineering and medical technicians.

14 As regards future development, the same reticence was shown as for high-level employment and little in the way of general conclusion can be drawn from the figures received except that in most cases the percentage increases are less than for high-level employment. This is perhaps to be expected since in many of the countries concerned expatriates still hold a majority of high-level positions and their early replacement is contemplated.

15 Table VI gives the breakdown of middle-level employment in two countries. The difficulty of direct comparison is shown by the differences in the pattern of analysis adopted and by certain obvious disparities e.g. the inclusion or exclusion of nurses in the figures relating to medical and health auxiliaries. (13·0 per cent as contrasted with 0·3 per cent).

16 Table VIB(1) is of interest in that it is one of the very few in which data concerning the employment of women is available.

(d) *Projected needs and planned output at middle-level.*

17 The reticence already noted in respect of high-level employment is repeated at the middle-level and relatively few replies have been received concerning either needs or planned output for 1970. Further, there has been some confusion as between 'additional needs' and 'total needs'. In Table V an attempt has been made to avoid the confusion but it may not have been entirely successful.

18 The figures for the planned annual output of technicians in 1970 also call for a cautious acceptance since they range from 1·4 per cent to 57·1 per cent of the estimated existing total at that date. If these extreme figures be disregarded the average lies between 7 per cent and 8 per cent, a not unreasonable value for a developing country with a reasonable existing stock.

(e) *Assessment of Manpower Needs*

19 Six of the participating countries either offered us comment under this heading or stated that the possibility of conducting a survey was under consideration. In three other cases manpower assessment was based on census figures, presumably at ten-year intervals, while in yet three others occasional assessments were made in specific areas of employment, often undertaken by visiting consultants.

20 The main body of replies indicated a continuing responsibility undertaken by a unit or department variously attached to a Ministry of Labour, a Ministry of Finance, or a Ministry of Economic Development.

(f) *Classified List of Occupations*

21 Of the eighteen replies received, six countries had adopted the standard system of classification prepared by the International Labour Office,[1] seven other countries had modified this classification to meet local needs, and five countries had developed their own systems.

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[1] INTERNATIONAL LABOUR OFFICE. International standard classification of occupations. Geneva, I.L.O., 1958.

Summary of Section I

22 The lack of much necessary information in the replies received makes it extraordinarily difficult to offer a reliable summary of this section. For what it is worth, the following would appear to be the characteristics:

(*a*) From 40 per cent to 45 per cent of the population is actively employed representing some 60 per cent of the males and some 25 per cent of the females.

(*b*) In the predominantly agricultural countries from 40 per cent to 70 per cent of the employed population are engaged in agriculture as against 10 per cent to 15 per cent in the predominantly industrial countries.

(*c*) In the predominantly industrial countries some 25 per cent of the working population is engaged in manufacture, some 20 per cent in commerce and trade, and some 20 per cent to 25 per cent in the social services. In the predominantly agricultural countries the corresponding figures are 10 per cent, 10 per cent and 15 per cent.

(*d*) In the developed countries some 5 per cent of the working population is employed at professional or higher level, and some 10 per cent to 12 per cent at technician or middle level. A typical breakdown of these figures is not possible in view of the different classifications adopted.

(*e*) No information is given concerning the rate of growth of trained manpower in the more developed countries. Any such figure must take into account replacements due to death, retirement or other causes; population increase; and development. As a basis for discussion it is suggested that 5 per cent per annum might be a reasonable figure for a developed country, rising to 8 per cent for developing countries with a reasonable initial stock.

(*f*) In most of the participating countries some arrangements are made for occasional or periodic assessment of manpower needs but undoubtedly much more requires to be done if reliable, up-to-date figures are to be made available for the preparation of training programmes.

(*g*) The newer established countries seem generally to have adopted the international classified list of occupations with or without modifications to suit local needs. The older established countries have generally developed their own systems but when modifications are made note is taken of international recommendations.

Section II

(a) *The Educational Basis for Technician Training*

23 With one exception, primary education extends over periods of from six to eight years the latter period sometimes embracing two years of intermediate or lower secondary education. Where this is so (Table VIII), the period of secondary education to School Certificate 'O' level or its equivalent, may be as short as three years as compared with the normal four to five year's period. In general, some eleven years are required to cover primary and secondary education up to this level.

24 As elsewhere, accurate analysis is made difficult by the different standards applied to the term 'technician' but, in general, a completed secondary school education is considered essential with success at School Certificate 'O' level, or equivalent, in two or more subjects. These are usually English and either mathematics or science, or both.

(b) *Secondary School Curricula*

25 The replies, where received, all indicated the provision of facilities for science, the study of which was generally made compulsory in the lower school. The position was less favourable with regard to the industrial and commercial arts subjects which were generally regarded as optional except where incorporated in the programme of a secondary technical school. A number of countries reported steps to establish secondary technical and comprehensive schools with improved facilities for scientific, industrial arts, commercial, and domestic studies.

(c) *Supply of Students for Technician Courses*

26 Of the nineteen replies received, no less than fourteen indicated a satisfactory demand for the places available, but in at least three instances the number of places was small and in others the recruitment was from a junior technical school, from trade courses, or from senior primary schools.

27 Two countries reporting on insufficient supply indicated that students possessing mathematics and science qualifications were not interested in technician careers, and it may be assumed that a similar reason obtained in the remaining two countries, one of which was able to recruit secondary school students for commercial courses but not for engineering.

(d) *Transfer from craft to technician training.*

28 Nineteen replies were received of which sixteen indicated transfer possibilities and only three reported their absence. The value of the replies was somewhat lessened by a general failure to state whether full-time or part-time courses were involved. Thus in some cases 'no' referred to transfer from one full-time course to another while permitting entry from a completed full-time course to later part-time courses undertaken during apprenticeship; such replies have been considered as 'yes.'

29 The general position appears to be that a majority of countries provide for 'end-on' transfers, for the most part to evening courses, and that transfers *within* full-time courses usually take place only in the earlier stages when outstanding performance shows that the original placement was in error. Where a 'no' reply was received consideration was said to be given to the early introduction of transfer facilities including scholarships tenable in other countries.

(e) *Pre-technician courses*

30 Only three of the twenty replies reported pre-technician courses, two of one year's duration and one of two years' duration. Of the others, one stated that the first part of the course was essentially pre-technician in character while a number indicated that gaps in the candidates' qualifications should be made good by attendance at part-time courses either before or concurrent with the technician course. In one case, entry was restricted to secondary technical

school students and the question did not arise but, generally, it would seem that most courses required only a basic knowledge of mathematics and science, with woodwork or metalwork as desirable additions.

(f) *Selection Methods*

31 Twelve of the twenty replies received indicated reliance upon the normal entrance qualifications supported, in a number of cases, by interview. Three others reported the use of aptitude tests combined with a written examination, and four the use of written examinations supplemented in one instance by a standard test completed in the secondary school. One reply indicated reliance upon the school record and interview combined with performance during a probationary period.

Summary of Section II

32 Subject to the same limitations as obtained for the previous summary, the following points would seem to emerge:

(*a*) Where the necessary educational facilities exist the normal requirements for entry to technician courses are a completed secondary education with examination successes in English, mathematics, and science.

(*b*) Most secondary schools now offer facilities for science teaching but opportunities for the educational handicrafts, office arts, and home economics, though improving, are in relatively short supply.

(*c*) In general, there appears to be little difficulty in filling the number of technician places offered but this may be due mostly to an insufficiency in the number of places provided. It is certain that in a number of the developing countries the distaste for manual work remains and that admission standards cannot always be maintained in consequence.

(*d*) Most countries make, or intend to make provision for successful craft students to enter technician courses, generally part-time in character: in many of the developing countries with a sparsely distributed population this may be difficult of achievement. Where full-time courses are available, promotion is likely to take the form of an early transfer rather than of an end-on progression.

(*e*) Post-secondary pre-technician courses are not generally favoured. Gaps in a candidate's qualifications have to be filled by attendance at supplementary courses taken either before entry or concurrently with the technician course.

(*f*) Admission to technician courses is generally based upon school records and examination successes, supplemented by interview and, in some cases, by a special entrance examination. In a small minority of cases, an aptitude test may be applied.

Section III

(a) *Types of Course*

33 As to be expected, the range of courses at the technician level is extremely wide and cannot be readily presented in summary form. Their length varies from one month to six years and their organisation includes full-time, sandwich, part-time day, evening, and correspondence courses. In the lesser developed countries with but few teaching centres the emphasis is necessarily on full-time courses with residential facilities whereas in the more developed countries the emphasis is on part-time courses which, in some cases, are open only to registered apprentices. Sandwich courses relating to one or more subjects are reported in six replies.

34 In the matter of assessment there is again a broad division between those who rely largely upon the City and Guilds of London Institute or the Royal Society of Arts and those who have set up their own National Examining and Registration Boards or make use of the examinations conducted by local professional bodies.

35 It is of interest to note that both the City and Guilds of London Institute and the Royal Society of Arts have established examinations especially designed to meet the needs of those oversea countries which use their facilities, and are prepared, subject to maintenance of standards, to amend their 'home-type' examinations to meet oversea needs where so desired. These several measures are regarded as temporary pending the transfer of full responsibility to such local bodies as the West African Examinations Council.

36 Relatively few replies were received concerning courses open to women. In the main these related to the commercial, domestic, and fine arts in which women have traditionally taken a large part.

(b) *Practical Trade Work*

37 Of eighteen replies all but two indicate that some provision is made for trade instruction. In six cases the time so spent is not stated but periods of from two to ten or more hours per week are given for the remainder. In general, the lesser period relates to part-time courses for students already in suitable employment while the longer period relates to full-time courses prior to employment. In a few cases, the full-time award is withheld pending completion of a post-course employment period.

(c) *Liberal Studies*

38 Only five of eighteen replies indicate the absence of any provision for liberal studies, the reason generally given being the lack of time in a part-time course. Of the others, all but one include English (from one to seven hours per week) as an obligatory course subject, together with social, economic, and supervisory studies either as obligatory or as optional subjects.

39 It should be noted that the term 'English' as a subject is capable of widely different interpretations ranging from 'technical English' in one case to 'public speaking, committee practice, and simple logic' in another.

(d) *Organisation of Courses*

40 Twenty replies were received showing wide variations in set-up from a single institution responsible for all levels and types of technical education to a multiplicity of institutions having separate responsibility for agricultural, commercial, and industrial education and training at each of a number of levels.

41 In general, commercial and industrial education and training at lower and higher levels were contained within a single institution, but agricultural education was carried out in a separate institution having residential facilities and providing its own work opportunities. A number of replies indicated the existence of 'departmental' schools providing in-service training for government employees, particularly those engaged in clerical and telecommunication work.

42 While, as noted, a large number of replies indicated that craft and technician training were carried out in the same institution it is thought that the former generally referred to training which was either supplementary or introductory to that received in actual employment. Vocational or trade training in the more limited sense was normally given in a separate 'training centre'.

43 Only three replies indicated residential facilities.

(e) *Industrial Experience*

44 As contrasted with the lack of information previously given, the replies received to the question concerning industrial experience seemed to indicate a preponderance of part-time courses in which students gained their practical experience while working on the job. Full-time students on the other hand, where previous employment was not a condition of entry to the course, were generally found vacation employment or were required to complete a post-course period of employment before confirmation of their award. In one or two cases only was difficulty expressed in finding suitable vacation employment: the existence of apprenticeship Commissions or Technician Certification Authorities and their advisory committees helped considerably in this as in other aspects of training.

(f) *Correspondence Courses*

45 Only two replies, New South Wales and New Zealand, indicate any considerable usage of official correspondence courses for students unable by reason of location or employment to attend the normal classes. The conditions for entry and award are identical with those for the class student. In the case of the first-named region the organisation and administration of the courses are undertaken by the School of External Studies of the Department of Technical Education.

46 Malaysia and Fiji report use of the above systems for certain of their requirements: the latter country refers to the appointment of government specialist officers to act as tutors and course supervisors.

47 Several countries refer to the development of private correspondence schools and to the occasional award of government bursaries covering individual fees for approved courses.

48 While an official reply is still awaited from the United Kingdom mention may be made of the long-standing correspondence courses developed for marine officers while at sea, supplemented by ad hoc oral tuition when in port. The Government has also announced its intention to introduce 'over the air' broadcast courses up to degree level.

49 An essential feature of the courses described is the 'block' attendance at a teaching institution for periods of 'consolidation' and laboratory work.

Summary of Section III

50 (*a*) The range of technician subjects is wide according to each country's need and cannot be readily presented in summarised form.

(*b*) In the lesser developed countries all subjects, with the possible exception of agriculture, have to be covered in a single institution operating at craft, lower technician, and higher technician levels.

(*c*) In the more developed countries the trend is towards a division of subjects and levels among separate institutions: in the United Kingdom this is represented in part by the creation of local, area, regional, and polytechnical institutions, together with colleges of advanced technology at the university level.

(*d*) In a number of countries schools parallel with the technical institutions have been established by government departments for the purpose of 'in-training'.

(*e*) This section of the enquiry has shown that a very large number of technician students are already in employment or have previous employment experience. Where this is not so, opportunities for vacational employment are sought or post-course employment experience may be a condition of award.

(*f*) Most countries recognise the value of liberal studies as a necessary part of technician training. English and social studies (including economics) are usually included whereas supervisory studies, where provided, are an additional option.

(*g*) Organised correspondence courses have been largely developed in Australia and New Zealand with export arrangements to some other Commonwealth countries in the Far East. In the United Kingdom the method is much used for the training of marine officers and may be extended in conjunction with broadcasting.

(*h*) In the absence of official correspondence course facilities, private organisations have played a large part in this form of education and training and are not infrequently used by governments.

Section IV

(a) *Central Examining Bodies*

51 Only eight of the twenty-one replies reported the establishment of a central examining body generally in direct association with the Ministry of Education or Department of Technical Education. Contact with industry and commerce was maintained either by the appointment of general and subject advisory committees or by consultation with representative bodies such as an Association of Professional Engineers. Under these circumstances little difficulty was experienced in securing both public and private recognition of the awards.

52 Nigeria, one of the eight countries referred to above, relies largely upon United Kingdom bodies for its technician examinations but, as already noted, is in process of transferring full responsibility to a Nigerian Technical and Commercial Examinations Committee in affiliation with the West African Examinations Council. Other countries using United Kingdom examination facilities, including the City and Guilds of London Institute, the Royal Society of Arts, and the London Chamber of Commerce, report little difficulty in securing public and private recognition of their awards although one states that this is more readily achieved for commercial than for industrial certification.

53 Most of the remaining countries rely upon awards given by the individual colleges or institutes which maintain contact with industry and commerce through a governing body or subject advisory committees. None appears to have difficulty in securing recognition of its certificates nor, obviously, is this a difficulty confronting government departments responsible for their own in-training schemes.

(b) *Teaching Aids*

54 Only four replies report even limited experience with programmed instruction. In one case the results are said to be satisfactory but in another case only moderate success has been achieved.

55 All countries report the use of visual aids but to an extent which varies from 'only limited use' to 'most extensive use'. Complaints concern the lack of material appropriate to local needs and of teaching staff competent to obtain full benefit from the material which is available.

Summary of Section IV

56 (*a*) The need to establish a central examining body follows upon a natural growth in the facilities for technical education and the decision to accept responsibility for a national system of examinations as distinct from that of another country.

(*b*) The value of close contact with industry and commerce is generally recognised in the appointment of consultative and advisory committees at both national and local levels. Such committees must be fully representative of the several interests served.

(*c*) Visual and audio aids are in general use but their full value can be achieved only if sufficient and appropriate material is available and if teaching staff are adequately trained in their use.

(*d*) The extent to which programmed instruction methods are used is very limited and does not justify comments upon their effectiveness.

Section V

(a) *Teacher training and supply*

57 Twelve of the nineteen replies received indicated dependence upon oversea training either in the form of expatriates possessing previous teaching experience or in that of local candidates admitted to oversea training institutions. In a number of such cases a start had been made by the introduction of refresher and up-grading courses, sometimes as the result of co-operation between a normal teacher training college and the technical institute, and there were proposals to establish technical teacher training colleges in the near future, notably in Nigeria where the college is scheduled to open in October of this year.

58 Practice in the remaining seven countries varied considerably from that of a one-month full-time course prior to employment to that of a proposed three-year full-time course concerned with advancement of technical knowledge as well as with principles of pedagogy. In almost all cases the full-time courses are or will be supported by short refresher and up-grading courses and, in some instances, by evening courses for actual and potential workshop instructors.

59 Details of technical teacher training practice in New South Wales are of particular interest. Full-time teaching staff, unless previously trained, are required as soon as possible after appointment to undertake a basic teacher training course extending over 500 hours and embracing the five subjects of (*a*) general methods of teaching, (*b*) special methods, taken in the teacher's own school, under supervision, (*c*) principles of technical education, (*d*) English expression, including oral communication, and (*e*) educational psychology. The course requires attendance for two days per week during the first year of service and full-time for three weeks at the conclusion of that year. In most cases it is preceded by one week of full-time training immediately before taking up appointment.

60 In the limited number of replies to 'the need for teachers by 1970' some of the submitted figures refer to total need and some to additional need. Unfortunately it has not been possible to separate one from the other and any attempt to express the results in tabular form could be misleading. Any value attached to the table would be further lessened by the number of important omissions. Attention can however be drawn to the considerable range of expressed need from a mere five in one instance to the gigantic total (additional) of 5,700 submitted by Nigeria. Of this total 3,750 are required to be at graduate level and from 30 per cent to 40 per cent are expected to be expatriates.

61 Most of the replies relating to expatriate employment expressed a continuing need at all levels below that of Principal, a post which it was frequently hoped to transfer to local candidates if this step had not already been effected.

(b) *Ancillary Staff*

62 In most replies this was interpreted as laboratory assistants or technicians for whom training was given either in the form of standard laboratory technician courses or by a system of in-service or on-the-job instruction.

63 In one or two cases workshop instructors were included in this category and reference was made to short courses of refresher or up-grading type.

Summary of Section V

64 (*a*) Despite the vagaries of the statistical information received, it is clear that there is a general recognition of the need to increase provision for the formal training of technical teachers if expanded programmes are to be met and a policy for localising the staff is to be pursued.

(*b*) Advances in the level of work undertaken are calling for higher standards of laboratory and workshop equipment and maintenance which can only be met by improved methods of laboratory technician training.

Section VI

(a) *Responsibility for technical education*

65 The majority of replies received indicated major responsibility vested in a Department or Ministry of Education except for agriculture and some departmental in-service training. In the case of apprenticeship, however, responsibility was shared with the Department or Ministry of Labour, concerned primarily with the practical training received in industry. In one extreme case, that of Swaziland, responsibility appeared to be divided among no less than four, or possibly five, different authorities. In countries possessing a federal structure immediate responsibility was vested in the individual regional or provincial ministries.

66 In most cases consultation with industry and commerce is, or is to be, effected through National Councils for Technical and Vocational Education and Training representative of the public and private interests concerned. The Councils work in close co-operation with Apprenticeship Boards or Trade and Technician Certification Councils and are frequently responsible for the appointment of advisory committees maintaining contact with the latest developments in their respective fields. In some instances their structure is repeated at regional and district levels but in others the whole burden of co-ordination may fall upon the Principal and staff of the teaching institution which may similarly appoint general and subject advisory committees.

(b) *Administrative arrangements and inspection*

67 Of the seventeen replies received, thirteen reported the appointment of an administrative assistant variously known as Assistant Director (Technical), Chief Supervisor or Inspector (Technical), Head of Department (Technical), Adviser or Assistant Adviser (Technical). In each such case the designated officer was responsible to the Chief Education Officer or Adviser.

68 Of the remaining four replies, two indicated that the Principal of the technical institution also acted as adviser for technical education and as such was directly responsible to the Director of Education or Chief Education Officer. The other two replies were of a quite different nature in that a technical education division or department was separately established with a head of division immediately responsible to the Minister.

69 Eight replies reported the appointment of a separate inspectorate, three stated that such duties were carried out by a headquarter's adviser and other staff, and three indicated reliance upon the Principal. In some cases inspection was carried out with the aid of industrial or commercial experts brought in for this purpose.

70 In the United Kingdom government inspection is organised both centrally and regionally but, in addition, some of the larger education authorities have established their own inspection systems.

(c) *Control*

71 Of twenty replies received, fifteen reported direct control by the Ministry of Education or other responsible government authority: in six such cases governing bodies or advisory boards had been appointed but their functions were entirely advisory. Four other replies indicated the appointment of governing bodies with powers limited only in respect of finance, and one a position in which some institutions were directly controlled while others, mainly sponsored by religious organisations, enjoyed considerable autonomy.

(d) *Boarding arrangements*

72 Only eight replies indicated the existence of boarding facilities, ranging from 'some' to 'all' pupils, in respect of industrial and commercial courses. In agricultural institutions it is common to board all students.

Summary of Section VI

73 (*a*) The Ministry of Education is commonly responsible for education and training at the technician level but at the craft level not infrequently shares its responsibility with the Ministry of Labour. In nearly all cases, however, responsibility for agricultural education and training rests with the Ministry of Agriculture.

(*b*) Responsibility for in-service training within government departments may either rest with the department concerned or be remitted to the Ministry of Education. The former may result in uneconomic duplication of courses and is often the first to suffer when expenditure has to be curtailed. The charge against the latter is that the training tends to be too academic and time-tabling too inelastic. Where, as in telecommunications, training must be given on highly specialised and elaborate equipment, it is common for the department concerned to establish its own schools.

(*c*) In general, the work of a Ministry of Education is divided into separate branches corresponding to the different levels of education (primary, secondary, etc.) each with an under-secretary responsible to the chief administrative officer or permanent secretary. In two cases, however, a separate administration has been created for technical education with its own secretary or director directly responsible to the Minister: the system has disadvantages as well as advantages.

(*d*) The enquiry has not brought out the fact that in some cases there is a sharp division between the executive and the administrative functions, the former being represented by a 'department of education' and the latter by a 'ministry of education'. Personal observation indicated that co-ordination of the two activities, and indeed of department and department where responsibility is so divided, leaves much to be desired.

(*e*) The replies indicate that inspection duties are commonly carried out but under conditions which vary from the observations of advisers and others carrying a diverse responsibility to the professional supervision of regional and national inspectorates. In contrast with some Continental systems, the inspector has limited powers of direct action and is generally regarded as one with whom problems can be discussed and guidance sought.

(*f*) In most cases the teaching institution is directly controlled by the Ministry of Education, or by the Local Education Authority in the United Kingdom, and governing bodies where appointed have advisory powers only. The trend, however, is towards a greater autonomy on the part of such bodies and in the United Kingdom a teaching institution is only recognised at the higher levels (e.g. polytechnics and regional colleges) on condition that this autonomy is given. This involves the power to appoint advisory sub-committees, to recommend appointments, to incur expenditures under approved heads of estimates, and to establish courses in consultation with regional advisory councils.

(*g*) The need for a full measure of co-operation with industry and commerce is now generally recognised by the appointment of councils (frequently with statutory powers) and advisory bodies at national, regional, and local levels. Such bodies are representative of public and private interests (including both 'sides' of industry) and, particularly at the local levels, are able to give valuable advice and practical assistance to the individual institutions.

(*h*) Apart from agriculture, the practice of establishing a few large centres in relatively isolated areas is diminishing and with it the need to provide a large proportion of residential student places. Recent researches by one international organisation, however, establish the fact that the cost of economical dormitory accommodation can be largely offset by savings in transport capital and recurrent costs and is often justified in terms of the better use of the educational facilities provided.

Section VII

(a) *Capital and Recurrent Costs per place*

74 Table VIII shows capital costs per teaching place from as low as £250 to the very high figure of £1,575: no comment was offered in respect of either figure. The only figure given in respect of boarding accommodation per place was that of £240.

75 Recurrent costs ranged from £40 to £420 per teaching place and from £30 to £110 per boarding place.

(b) *Fees and Scholarships*

76 In general, fees where stated are not only nominal in relation to the recurrent costs but are nominal in their application since they are often remitted or refunded by employing organisations, including government departments. In many cases scholarships covering tuition and boarding fees are available, occasionally including a small weekly sum as pocket money.

77 None of the replies referred to the existence of a loan fund.

Summary of Section VII

78 (*a*) The bare facts of Table VIII are of little value in themselves since they do not disclose differences of building costs per square foot, sources of equipment, size of classes, and similar such items affecting the cost of a student place. Personal observation has shown construction costs varying from £1 5s. 0d. to £5 5s. 0d. and more per square foot: equipment costs varying from 30 per cent to 12 per cent of construction costs depending on source of supply; insurance, transit, and import charges; nature of the courses offered; and the relative costliness of construction: and boarding accommodation ranging from 30 square feet per place (double bunk dormitory construction) to 150 square feet per place (single-bed study plus social accommodation).

(*b*) As a basis for discussion the following guidelines are put forward for a non-residential institution offering a fair selection of general, industrial, commercial, and domestic courses together with normal social and administrative facilities.

Construction: 80–100 square feet per place.

Furniture and equipment: £125–£175 per place.

With construction at £5 per square foot the capital cost per place under the above conditions would lie between £525 and £675.

(*c*) Recurrent costs as shown in Table VIII are similarly varied, from £40 to £400 per place. Since some 65 per cent to 80 per cent of these costs are normally represented by teachers' salaries and the sizes of class may normally vary from 10 to 40, it is obviously not possible to give even an approximate estimate of what such costs should be, especially is this the case where expatriates form a high proportion of the total teaching strength.

(*d*) Fees are obviously and essentially nominal. Even so it would seem that in most cases they are met by the employer or by direct remission. In some cases, remission applies to all students below a certain age (18 or 19 years) and in one interesting case the student is entitled to fee remission for five years of post-primary education, whether secondary or technical.

(*e*) Despite the negative replies, the loan system is certainly in use elsewhere and would appear worthy of consideration. In one reported instance the obligation to pay a provisionally remitted fee can be met by an undertaking to serve in a government department for the year immediately following the completion of the course.

Section VIII

(a) *Present and future Commonwealth Assistance*

79 This section of the enquiry was considered 'not applicable' to Australia, Canada, New Zealand, and Papua and New Guinea who replied accordingly.

80 Of the remaining fifteen replies, twelve indicated past or present assistance, and fifteen indicated the need for some future assistance. The exact details are varied and would seem more properly the subject of discussion between those countries and the probable donor countries. The following summary indicates the main channels along which help is needed.

Summary of needs expressed in Section VIII

81 (*a*) Advisory service in the preparation of future development plans.

(*b*) Financial assistance towards projected construction costs, ranging from £26,000 to nearly £1·5 million and totalling more than £2·5 million.

(*c*) Expatriate staffing need assessed at more than 2,000 in the case of Nigeria but of more modest dimensions (total 120) elsewhere.

(*d*) Training places overseas.

Section IX

82 The main planned developments are shown in Table IX.

APPENDIX A

Statement of Background Information required from Governments to enable assessment of present and planned programmes for technician education and training to be prepared.

Notes:

1. Constitutional federalism in education may make it desirable for some countries to provide some information on a state, provincial or regional basis. Also it is recognised that in some cases estimates and approximations may have to be given.

2. The information sought in this paper is required by 31st March 1966.

Section 1

Manpower Statistics (see notes at end of Section 1)

(*a*) Total population

(*b*) Economically active population
(Working population)

(*c*) Major industries

(*d*) Existing stock of high-level manpower

(*e*) Existing stock of technicians and other middle-level personnel

(*f*) Projected need by 1970 of high-level manpower

(*g*) Projected need by 1970 of technician and other middle-level personnel in scientific, agricultural, commercial and technical employment

(*h*) Planned annual output in respect of sub-section (*g*) by 1970

(*i*) Arrangements for assessing manpower needs

(*j*) Do you use a register of occupations classified according to the international list compiled by the International Labour Office?

Notes:

(i) *High-level manpower is defined as follows:*

Includes top administrators and managers of sizeable establishments (public and private) and professionally trained people of all kinds including qualified teachers. The qualifications required for such posts, where specified, would normally be a university degree or an equivalent professional qualification and a minimum period of experience in a senior capacity. Alternatively, a longer period of experience in a senior capacity together with good ability is often acceptable.

(ii) *Intermediate-level or technician, etc., level manpower* is broadly defined in Conference Paper C.E.T.T.(G) 2.[1]

> It includes technical and supervisory personnel, who often hold executive or supervisory positions, but do not make policy. They normally require a training period of from 2–4 years at a post-school certificate level followed by experience on the job. Since they are in the nature of a communications link between the high-level and the skilled-level personnel they are also expected to know something of the work and responsibilities of these categories. They include, for example, engineering and science technicians, agricultural assistants, assistant chief clerks, draughtsmen, assistant managers, foremen, etc.

(iii) Countries with well developed manpower statistical units are invited to enlarge upon their manpower information, classifying it either by industry or by main occupation. They may also wish to indicate the percentage factors used to take account of such items as wastage, proportion of individuals promoted on experience, i.e. without training, etc.

Section 2

(*a*) What is the educational basis for technician training?

(*b*) Do your secondary schools include science or practical options such as woodwork and metalwork, or other technical or commercial subjects in their curricula?

(*c*) Does the output of your secondary system provide an adequate supply of entrants for technician training? If not, how do you meet the shortfall?

(*d*) Have you arrangements for entry to technician training from the craft level?

(*e*) Do direct entrants from secondary schools undertake any preliminary or special training before undertaking technician training proper?

(*f*) What selection methods do you use for direct entrants?

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[1] The broad stratum between the skilled craftsman and the technologist, which covers a range of personnel with wide differences both in subject interests and in degree of expertise, generally known in industry as technicians. Some technicians are properly and necessarily craftsmen who have added technical and perhaps supervisory knowledge to their skills. At the other end of the technician scale are those who, whilst lacking the broad mathematical and scientific background of the technologist, approach his theoretical knowledge on a narrower front and may well carry a very high degree of specialist responsibility. Between these extremes are various gradations.

Although the term 'technician' is in general use in the field of engineering and, to some extent, in the metal and chemical industries, intermediate-level personnel in the range indicated above may be identified in all areas of industry and commerce, e.g. typists may be considered to be at the craft level whilst secretaries may properly be regarded as an example of 'technicians' in the business world.

Section 3

(*a*) What types of technician course do you offer? By whom assessed? Are they open to men and women?

(*b*) Do your engineering and building courses include an element of practical trade work?

(*c*) Do you include liberal studies in your technician courses? Supervisory studies? Library work?

(*d*) How is your technician training organised?

(*e*) What arrangements do you make to ensure that students undertake industrial experience?

(*f*) To what extent are correspondence courses provided, and how are they organised?

Section 4

(*a*) Do you have a central examining body for technical subjects? If so, how do you ensure that examinations meet industry's needs? Are all the qualifications obtained recognised by industry and by Government?

(*b*) Do you use any form of programmed instruction? Visual and audio aids? With what success?

Section 5

(*a*) What arrangements do you make, or propose to make, for the training, up-grading, retraining, etc., of technical teachers and instructors? How many new teachers will be needed by 1970? How many of these should be graduates?

(*b*) Will you be using expatriate staff in your institutions? At what level?

(*c*) What are you doing to make provision for ancillary staff?

Section 6

(*a*) Which Ministry in Government is responsible for technical education? What arrangements does it make to consult industry and commerce and to co-ordinate the provision of technical training, if necessary, with other Government Departments?

(*b*) What administrative arrangements does your Ministry make to deal with technical education matters? Who is responsible for inspection arrangements and what are these?

(*c*) Does your Ministry control the Colleges direct or are there Boards of Governors for each? If the latter, what powers do they have?

(*d*) Are boarding arrangements available for students?

Section 7

(*a*) What is the estimated (*a*) capital, (*b*) recurrent cost per technician student place?

(*b*) Are fees charged? If so, are students provided with assistance by way of scholarships, bursaries, loans?

Section 8

(*a*) Are you currently in receipt of Commonwealth assistance? If so, of what kinds?

(*b*) Will you require further assistance up to 1970? If so, what and how much?

Section 9

Have you any special features in your current planning for technician education and training which are not covered above, e.g. plans to establish new colleges or courses?

APPENDIX B

Tables I—IX

TABLE I

Population and Employment (× 1,000,000)

No.	Country	Total population × 10^6	Actively employed × 10^6	%	Actively employed M	F
1	Aden (Colony)	0·263				
2	Australia (N.S.W.)	3·917	1·603	40·9	60·5	21·1
3	,, (Victoria)	2·930	1·210	41·3	60·2	22·2
4	,, (all)	10·508	4·225	40·2	59·6	20·0
5	Bahamas	0·130	0·062	47·7	45·2	50·2
6	British Solomon Islands	0·130				
7	Canada	19·646	7·141	54·1		
8	Ceylon	11·200	3·550	31·7		
9	Cyprus	0·598	0·243	40·7		
10	Fiji	0·464	0·126	27·2		
11	Gambia	0·315	0·010	3·2		
12	Gibraltar	0·024	0·015	62·5		
13	Hong Kong	3·133	1·212	38·7		
14	India	439·200	188·671	23·3		
15	Malawi	3·620	0·155	4·3		
16	Malaysia	7·250				
17	Malta	0·329				
18	Mauritius	0·682	0·187	27·4		
19	New Zealand	2·640	0·984	37·3		
20	Nigeria	55·600	8·250	14·9		
21	Papua and New Guinea	2·149	0·105	49·0		
22	Swaziland	0·295	0·152	51·5		
23	Trinidad and Tobago	0·972	0·346	35·6		
24	Uganda	7·735	3·375	43·6		
25	U.K. (England & Wales)					

Note: In general, the data relates to census years for which both population and employment figures are available. Later estimates show considerable increases in the population figures, but are not accompanied by employment figures.

TABLE II

Distribution of manpower among major industries

Type of Industry	% of employed population				
	A.1	A.2	A.3	B.1	B.2
Agriculture, fisheries, and forestry	69·5	57·3	37·9	12·2	9·1
Mining and quarrying, oil	2·8	1·8	—	1·9	0·4
Manufacturing	10·6	5·0	14·6	21·7	31·3
Construction	1·1	6·9	10·6	6·7	8·4
Public utilities	1·6	5·5	6·3	9·3	10·5
Commerce and trade	4·1	10·6	10·0	18·8	19·2
Social services (including Govt.)	10·3	12·1	18·7	27·0	19·0
Other		0·8	1·9	2·4	2·1
	100·0	100·0	100·0	100·0	100·0

Notes.

1. A:—predominantly agricultural countries.
   B:—predominantly industrial countries.
2. Certain professional services are variously included in social services and commerce and trade.

TABLE III

High-level manpower (× 1,000)

	Country	Current position			1970	
		Total employed	H.L.M.	%	H.L.M.	% increase
1	Aden (Colony)					
2	Australia (N.S.W.)	1,603	87·4	5·5		
3	,, (Victoria)	1,210	68·9	5·7		
4	,, (all)	4,225	233·1	5·5		
5	Bahamas	62	3·2	5·1	4·8	50
6	British Solomon Islands					
7	Canada	7,141	575·3	8·1		
8	Ceylon	3,550	1·8	neg.	5·6	210
9	Cyprus	243	0·0(8)	,,	0·1	25
10	Fiji	126	0·7	0·6	1·1	57
11	Gambia	10	0·3	3·0		
12	Gibraltar	15	0·3	2·0		
13	Hong Kong	1,212				
14	India	188,671				
15	Malawi	155	0·0(3)	neg.	1·1	—
16	Malaysia					
17	Malta					
18	Mauritius	187				
19	New Zealand	984				
20	Nigeria	8,250	15·1	0·2	28·3	87
21	Papua and New Guinea	105	0·9	0·9		
22	Swaziland	152	0·3	0·2	0·4	33
23	Trinidad and Tobago	346	14·8	4·3	20·8	40
24	Uganda	3,375	3·5	0·1	4·7	34
25	U.K. (England and Wales)					

TABLE IV

Distribution of high-level manpower

A : Smaller countries (population less than 1 million)

Field of appointment	%
Professional and supervisory	48·8
Executives and business management	26·5
Professional services	24·7
Total	100·0

B. Larger countries (population exceeding 1 million)

Field of employment	% (1)	% (2)
Engineering, architecture, survey	14	7·5
Physics, chemistry, geology	3	1·9
Biology, agronomy, veterinary science	2	1·0
Medicine and health services	12	21·7
Education	41	32·9
Religion	6	5·9
Law	4	2·2
Commerce, economics, library, statistics	13	21·4
Administration (government)	5	
Art, music, literature		5·5
Totals	100	100·0

N.B. The percentages for middle-level employment corresponding to IV.B(1) are given in Table VI.B(1).

A : Bahamas
B1 : N.S.W.
B2 : Canada

TABLE V

Middle-level and technician manpower (× 1,000)

No.	Country	Current position			1970		
		Total employed	M.L.M.	%	M.L.M.	Increase	
						%	Annual
1	Aden (Colony) . .						
2	Australia (N.S.W.) . .	1,603	187·3	11·7			
3	,, (Victoria) . .	1,210	124·7	10·3			
4	,, (all) . .	4,225	491·6	11·6			
5	Bahamas . . .	62	3·0	4·8	5·0	67	0·18
6	British Solomon Islands .						
7	Canada . . .	7,141					5·00
8	Ceylon . . .	3,550	8·2		23·4	185	1·90
9	Cyprus	243	0·5		0·7	40	0·40
10	Fiji	126	8·8		11·7	33	0·47
11	Gambia	10	0·7	7·0			
12	Gibraltar . . .	15					
13	Hong Kong . . .	1,212					
14	India	188,700					
15	Malawi . . .	155	0·6	0·4	5·1	750	0·4
16	Malaysia . . .						
17	Malta						
18	Mauritius . . .	187					
19	New Zealand . .	984					
20	Nigeria	8,250	48·6	0·6	95·6	97	8·40
21	Papua and New Guinea .	105	2·1	2·0			
22	Swaziland . . .	152	0·5	0·3	0·6	20	
23	Trinidad and Tobago .	346	15·8	4·6	22·2	40	0·30
24	Uganda . . .	3,375	8·6	0·3	10·5	22	2·00
25	U.K. (England & Wales)						

TABLE VI

Distribution of middle-level (technician) manpower

A. *Small countries (population less than 1 million)*

No available data.

B(1). *Larger countries (population exceeding 1 million)*

Field of employment	Male	Female	Total
Managerial and Senior Clerical	74·0	26·0	58·0
Other clerical workers	8·0	33·0	16·0
Medical & health auxiliaries	1·5	38·0	13·0
Transport and communications	5·5	Nil	4·0
Draftsmen and tracers	5·0	1·0	4·0
Laboratory technicians	1·0	1·0	1·0
Others	5·0	1·0	4·0
Totals . .	100·0	100·0	100·0

(To be compared with Table IV.B(1).)

TABLE VI—(*continued*)

B(2).

Field of employment	%
Administration	34·2
Education	19·5
Police and customs	19·5
Agriculture	9·6
Accountancy	9·1
Transport and communications	3·2
Construction and survey	1·8
Manufacture	1·5
Domestic and catering	0·7
Medical and health auxiliaries	0·3
Others	0·6
Total	100·0

TABLE VII

Educational basis for technician training

No.	Country	Primary edcn. years	Secondary Education			Entry exam	
			Years	Science	H'cf'ts	Type & No. subjs.	Oblig.
1	Aden (Colony)	4+3	4	Yes	Few	S.L.C3	1, 2, 3
2	Australia (N.S.W.)	6	4	Yes	Yes	S.C.	
3	(Victoria)	6	4	Yes	Yes	S.C.	
4	(All)						
5	Bahamas	6	5	Yes	Few	S.L.C2	1, 2
6	British Solomon Islands	4+3	4			Various	
7	Canada	6–8	4–6	Yes	Yes	School Record	
8	Ceylon	7	5			S.C.6	1, 2, 3
9	Cyprus	6	4–6			S.L.C4	1, 2
10	Fiji	8	4	Yes	Some	S.C.3	1, 2, 3
11	Gambia	6	4–5	Yes	Few	S.C.L	Spec.
12	Gibraltar	6	5	Yes	Yes	S.L.C2	1, 2
13	Hong Kong	6	5	Yes	Some		Spec.
14	India						
15	Malawi	8	4	Yes	No	S.C.	
16	Malaysia	6	5	Yes	Yes	S.C.3	1, 2, 3
17	Malta						
18	Mauritius	6		Yes	Few	S.C.L.	
19	New Zealand	6+2	3	Yes	Most	S.C.L.	
20	Nigeria	6–8	5	Yes	Few	S.C.4.	2, 3
21	Papua & New Guinea	6–7	3	Yes	Yes	I.C.	
22	Swaziland	5	5	Yes	Wood-work		Spec.
23	Trinidad and Tobago	6	5	Yes	Some	S.C.2	1, 2/3
24	Uganda	8	4	Yes	Some	S.C.3	1, 2, 3
25	U.K. (England and Wales)	6	4–5	Yes	Yes	S.C.3	1, 2, 3

TABLE VII—(*continued*)

Notes: (*a*) I.C. (4) = Intermediate Certificate, four subjects.
S.L.C. = School Leaving Certificate.
S.C.L. = School Certificate Level.
S.C. = School Certificate ' O ' Level.
Spec. = Separate entrance test.

(*b*) 1. = English.
2. = Mathematics.
3. = Science.

TABLE VIII

Costs and fees per place (£ *sterling*)

No.	Country	Cost per place				Fees per annum		
		Capital		Recurrent				
		Teaching	Board	Teaching	Board	Full-time	Board	Part-time
1	Aden (Colony)			165/180		10·5		1·5/3·75
2	Australia (N.S.W.)	400		92		12/24		4/12
3	„ (Victoria)							10
4	„ (All)							
5	Bahamas	700		210		16		
6	British Solomon Islands							
7	Canada	1,575		385/420		0/87		Low
8	Ceylon			51		Nil		Nil
9	Cyprus	600		40/100	80	12/14	40	7/12
10	Fiji	580		85		18		0/10
11	Gambia					Nil		Nil
12	Gibraltar			100		Nil		Nil
13	Hong Kong	600		75		25		3/5
14	India							
15	Malawi	800	240	220	80	Nil	Nil	Nil
16	Malaysia			185		28	60	5/14
17	Malta							
18	Mauritius					18/20		
19	New Zealand							
20	Nigeria	600/700		180	71	15/20	30/40	2/5
21	Papua and New Guinea	400		116	60	Nil	Nil	Nil
22	Swaziland							
23	Trinidad and Tobago	250		100	30	Nil	Nil	Nil
24	Uganda	750		400	110	50	30	2
25	U.K. (England and Wales)							

TABLE IX

Future developments

Country	*New proposals*
Aden	Trade school (100) for the Protectorate.
Australia (N.S.W.)	Development of suburban technical colleges.
Australia (Victoria)	Development of trade and technician courses.
Bahamas	Development of commercial and hotel courses.
Canada	Planning of 18 provincial schools.
Ceylon	Expansion Ceylon Technical College. Upgrading of three junior technical schools.
Cyprus	Planning of Higher Technical Institute. Creation of a Productivity Centre.
Fiji	Expansion of Derrick Technical Institute.
Hong Kong	Technical Institute to take lower technician levels.
Malaysia	Polytechnics (2). Trade Teacher Training College. Secondary technical schools (2): Trade school (1).
Mauritius	University (including technician courses).
New Zealand	Institute of Technology (including technician courses).
Nigeria	Expansion of existing technical colleges.
Papua and New Guinea	Institute of Higher Technical Education, Port Moresby. Technician courses in civil engineering.
Trinidad and Tobago	Commercial Institute. Vocational schools (7).
Uganda	Upgrading existing technical schools.

Discussion in Plenary Session

In presenting his paper, Mr. Jones mentioned some of the complexities of the task of trying to provide an assessment of the present provisions made for technician education and training in all Commonwealth countries. Governments had been asked to complete a questionnaire in order that such an assessment could be made and, although one or two replies had not been received in time for inclusion in the paper, section I and its associated tables were as complete and as accurate as the returns allowed.

It was suggested that the most appropriate organisation for the primary and secondary educational system of a developing country is a 4 + 4 + 4 basis. The organisational difficulties of endeavouring to provide different kinds of post-secondary education on one campus were underlined although it was pointed out that, provided there is no confusion over the aims and purposes of the various courses, considerable benefits can be obtained.

Considerable stress was laid on the need to provide properly trained teachers in order to ensure proper use of expensive equipment. Attention was also drawn to the importance of ensuring that the right type of equipment is available in institutions: this is important not only from the teaching aspect—it is frequently easier to illustrate basic principles through the use of an obsolescent machine—but also from the industrial aspect—there is little point in training technicians on highly sophisticated complex equipment which is non-existent outside the teaching institution.

An outline[1] was given of the World Bank's growing commitment over the past few years for assisting with the financing of educational programmes and the general procedures for handling applications to the Bank for loan finance were explained. It was pointed out how the United Nations programmes differed from the loan programmes of the World Bank. The need for planning to make technician education and training a continuous process was emphasised.

The view was expressed that the Conference had paid insufficient attention to the problems of training and educating agricultural technicians. The great importance of training in this field was emphasised and it was suggested that there is need for a future Commonwealth conference of experts in order to study in detail the specific problems involved.

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[1] Conference Paper C.E.T.T.(P)7/5 (*see* Appendix II).

CHAPTER XII

Aid Patterns and Commonwealth Co-operation

Lead paper presented by Mr. R. K. A. Gardiner, Executive Secretary, United Nations Economic Commission for Africa, Addis Ababa, Ethiopia.

Note: This paper was introduced in Mr. Gardiner's absence by Mr. S. Edokpayi (UNECA).

Introduction

1 An abiding fact of life for those states we call developing countries is their reliance on help from industrialised countries in the development of their human resources. Up to now, this has been particularly true of the technical personnel needed in industry, agriculture and commerce: I see no reason to believe that it will cease to be true in the immediate future.

2 According to one estimate, something like 100,000 skilled personnel are supplied to developing countries under a variety of official technical assistance programmes; another 160,000 come from private sources—50 per cent of this supply being middle-level manpower. This external contribution accounts for more than 2 per cent of the high-level and middle-level manpower resources in developing countries.[1] Apart from this help in terms of skills and brains, external aid also comes into developing countries in the form of direct financial assistance, scholarships, materials, and equipment for educational programmes.

3 In this discussion of 'Aid Patterns and Commonwealth Co-operation' I should like to pay particular attention to a few topics which are of special interest to the Economic Commission for Africa. Firstly, I shall try to pinpoint areas in which Africa's need of assistance in education is greatest; I shall try to describe the kind of assistance which is most urgently needed; and I shall attempt to put the case for concerted action by the aid-giving countries in support of regional programmes of education and training.

Aid Patterns in Africa

4 Before independence, educational aid from rich countries to poor countries was almost exclusively a matter of a transaction between the 'metropolis' and the dependent territory. It took various forms, including the charitable activities of missionary societies and programmes supported by philanthropic agencies; then, from the 1920's, a systematic approach was introduced by the United Kingdom in the shape of the Colonial Development and Welfare Fund. With the emergence of many of the former dependencies into independence, this colonial pattern changed: a new era opened, characterised by direct approaches by the new states to the United Nations and its Specialised Agencies, as well as to individual donor countries.

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[1] MADDISON, A. Foreign skills and technical assistance in economic development. Paris, O.E.C.D., 1965.

5 External aid to developing countries has, consequently, become more complex; there is a multiplicity of sources, forms and values; aid today supports a bewildering variety of development projects.

6 A striking feature of the aid picture is the fact that probably less than one-quarter of total aid to developing countries is channelled through multilateral agencies. Country-to-country (or 'bilateral') aid predominates. One instance of this is the supply of technical personnel; in 1963, member countries of the Organisation for Economic Co-operation and Development furnished some 82,000 experts to developing countries; the Sino-Soviet countries sent out 9–11,000; while multilateral agencies supplied only 8,000.[1]

7 Then there are two new, and very welcome, features in the pattern of aid programmes which have made their appearance in recent years. Firstly, the better equipped of the developing countries have begun to play a significant role in the provision of technical assistance for their less fortunate neighbours. This is particularly true of the Council for Technical Co-operation in South and South-East Asia—which we know as the Colombo Plan. The second new element has been the emergence of consortia for providing aid from various sources. In education, for example, several developed countries have contributed individually, or have combined together to help in the development of African universities.

8 However, most newly independent countries still rely on the former metropolitan countries for the bulk of their external assistance, even though the United States is entering increasingly into this field. In Africa, for example, old ties continue to have a large influence on the patterns of external aid. It is to Africa that some 80 per cent of technical assistance personnel, and nearly 45 per cent of the scholarships provided by OECD countries, have gone in recent years.[2]

9 Another interesting feature is the geographical distribution of aid: one notices that each of the largest donor countries tends to concentrate its activities in aid within a group of countries in a given region; an example of this is United States aid in South-East Asia, in Africa south of the Sahara, and in Latin America; French aid is largely concentrated in North Africa; most Belgian aid goes to Central Africa; and the greatest concentration of British aid is in East and West Africa. Thus we find that more than 80 per cent of all French teachers sent to developing countries under technical assistance programmes have gone to the Maghreb countries; of 13,500 United Kingdom technical assistance personnel sent abroad in 1963, 8,000 were for East Africa.[3]

10 There are also, of course, cultural factors at work, and these have their effect on patterns of aid to developing countries. Thus, French aid will, understandably, be more readily available to French-speaking countries; similarly, it is to the English-speaking countries that the lion's share of aid from the United Kingdom, the United States and other English-speaking donor countries, will tend to go.

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[1] Ibid, pp. 28–30.

[2] Ibid, Tables 2, 3, 4 and 5.

[3] Ibid, pp. 21–33.

11 This, as I have said, is understandable; but I beg leave to doubt whether it is either necessary or desirable. In fact, the experience of developing countries belonging to these two main language groups has shown that frequently the aid received corresponds neither to their real needs nor to their capacity to absorb aid. Some idea of what I mean can be gained by looking at the figures for 1960, when bilateral aid from official sources in OECD countries varied from approximately US $1 per head in Ethiopia, Ghana and Tanzania, to over US $32 per head in Algeria.[1]

12 Aid programmes are, however, beginning to be more realistically geared to the need to improve the human resources of developing countries. Ten per cent of all bilateral aid flowing to developing countries is devoted to a variety of educational programmes; it forms, indeed, a significant part of the aid programmes of some of the major donor countries. Under the Colonial Development and Welfare Acts in the United Kingdom, educational aid between 1959–1962 represented more than one-fifth of total aid; nearly half of the technical assistance personnel which OECD countries have sent to developing areas in recent years has consisted of experts and teachers whose mission has been to help in the building up of educational systems.[2]

Weaknesses in aid patterns

13 Even gift horses may be flawed: the gift horse of external aid is not without shortcomings. There are, for example, the inequalities in geographical distribution of aid which tend to divide developing countries into 'preferential zones' and 'less favoured zones'. Equally, there is the fact that only a handful of countries bear the bulk of the direct and indirect burden involved in providing aid.

14 Because of old ties and special links, a kind of exclusiveness has developed in certain forms of aid; this is particularly true of educational aid. The result is that a number of developing countries have found themselves relying too heavily on a single source of aid. The danger here is an arbitrary curtailment of the recipient country's area of choice and of its sources of inspiration, particularly where there may be a need to plan radical reforms in the educational system.

15 Again, there is the question of criteria for granting aid: while it would seem obvious that these should be based upon the development needs of the recipient country, too often we find that it is the political, commercial, and cultural interests of the donor country which dictate the kind and quantity of aid to be given when such aid does not coincide with the needs and interests of the recipient country.

16 Then there is what might be called the 'alms race': a kind of competition among the richer countries to bring aid to the poorer ones—an admirable development in itself, but one with some disturbing by-products, including, sometimes, the diversion of aid into low priority projects, duplication, and inconsistency in programming at the national level which may frequently be traced directly back to conflicts of philosophy or ideology among donor countries.

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[1] CERYCH, L. Problems of aid to education in developing countries. New York, Praeger, 1965. p. 179.

[2] OVERSEAS DEVELOPMENT INSTITUTE. British aid; (part 5) Colonial development. London, O.D.I., 1964. p. 57 (table 6).

17 In addition, the preponderence of bilateral programmes in the total aid picture means that there has been no significant development of regional or multi-national programmes of aid. It has, indeed, been very difficult to interest donor countries in multi-national development projects aimed at harmonising the economies of countries within the same geographical area, even though such programmes could be far more productive, through economies of scale and rationalisation, than many of the isolated projects to which too many bilateral donors seem to be fatally attracted.

18 Again, in educational aid, there is what has been described as 'non-convertibility': scholarships are generally tied to institutions within the donor countries, just as financial grants are tied to material and equipment supplied by the donor countries. The principle, which should be basic, of offering facilities for training which do not already exist in the recipient country, is too often disregarded. There is also an obvious advantage in awarding scholarships for study, training or research in third-party countries—neighbouring countries with adequate facilities.

19 I offer one more criticism: too little attention has been paid by the drafters of aid programmes to the need to train indigenous middle-level personnel in agriculture and industry. We find, for example, that less than 8 per cent of the 38,000 teachers supplied by OECD countries in 1963, were for middle-level and vocational schools. In too many cases experts have been provided to look after routine and maintenance services for which indigenous personnel could have been rapidly trained, if a more rational approach had been adopted in the first place.

Africa's need for educational aid

20 If African human resources are to be harnessed to the continent's efforts at economic development, it is clear that we must look both inside and outside the continent for means of developing education at all levels. It is only logical, given the fact that resources are limited and that there are competing claims, that the greater portion of educational aid from abroad should be deployed in developing those types and levels of education which can most quickly and most effectively stimulate economic growth.

21 Since one of the clearest development objectives for African countries is the transformation of their economies through industrialisation and the modernising of agriculture, educational aid should be increasingly devoted to developing the skills and attitudes needed to bring this about. Aid ought surely, therefore, to be directed towards the training of the teachers who will themselves produce teachers of new skills; towards an adequate supply of teaching material and equipment in the field of science and technology; towards the building up of multi-national training institutes and research centres; towards helping Africans gain technical and managerial experience in industries and institutions in the industrialised countries; towards providing technical experts and advisers to assist African countries with their educational planning and research; and towards the provision of 'soft loans' for development projects in those economic sectors which have the greatest potential for stimulating African economies.

22 Speaking as a representative of an institution which is dedicated to the ideal of African self-help, I should like to see such external educational aid as is destined for undergraduate training being directed mainly towards achieving the fullest development and use of local universities and specialised institutions. Foreign awards for overseas training could then be used in developing critical skills at post-graduate and the higher technical levels. It is my view that practical training through overseas attachments should be considered as being of equal importance with scholarships for academic studies.

23 We feel that in providing experts for technical assistance, donor countries should make an important distinction between executive and administrative personnel for routine operational activities, on the one hand, and experienced high-level experts for consultancy and supervisory tasks, on the other. While the demand for teachers will still be substantial for some time to come, the need will be greatest at the level of university teachers, science and technical teachers, teacher trainers, educationists and experienced agricultural and industrial field staff capable of training local counterparts in effective extension services. We must endeavour to alter the old disproportion of experts in public administration, social services and primary school teaching, and readjust the balance in favour of the new priorities I have described.

Special needs for technical personnel

24 In a report prepared by the Economic Commission for Africa earlier this year for the Symposium of Industrial Development in Africa held in Cairo, it was estimated that between 1965 and 1975 Africa—excluding the Republic of South Africa—would need to train over 50,000 additional scientists, engineers and technologists, over 100,000 technicians and foremen, and more than 1½ million skilled and semi-skilled workers, for its industrial development. In addition, a substantial number of technicians and skilled workers will also be needed in agriculture, commerce, transport and allied services.[1]

25 The best available figures show that in 1963 and 1964 less than 400,000 students were enrolled in African secondary technical and vocational courses. Present projections indicate that the potential annual output of technicians in Africa will rise to nearly 100,000 by 1975. At this level, the local supply of middle-level technical personnel will certainly fall far short of the needs.

26 The Addis Ababa Educational Plan set a target for Middle Africa of a secondary school enrolment rising from 1·8 million in 1965–66 to some 5·9 million in 1980. If we assume a 20 per cent enrolment in vocational and technical courses, we can hope to see about 1·2 million students in this category enrolled by 1980. The plan also envisages that by 1980 the demand for secondary school teachers will rise to 25,500, starting from a demand of 21,300 in 1965–66.[2]

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[1] UNITED NATIONS. Economic Commission for Africa. Some aspects of manpower requirements and the training of technical and managerial personnel for industrial development. UNECA document E/CN.14/AS/1v/9. Table 3.

[2] UNESCO. Outline of a plan for African Educational Development. UNESCO, Paris, 1961. (Unesco/Ed./180).

27 All this implies enormous requirements in technical personnel, classrooms, teachers, school workshops, equipment, technical textbooks, funds and opportunity for industrial experience. It seems to me that these are needs which deserve the support of external assistance. In a paper on 'Aspects of Economic Development'[1], presented to the African Conference on Progress through Co-operation, held in Kampala, Uganda, in 1965, Professor Arthur Lewis pointed out that the region's development programmes cannot be executed without skilled manpower. 'The highest priorities in Africa are science and skill', he said. This statement is, to my mind, an essential guideline both for African governments and for potential purveyors of aid.

28 I should like also to make a few specific suggestions on the form and direction which educational aid to Africa might take with a view to the building up of an adequate cadre of indigenous technicians and craftsmen, always bearing in mind the need to maintain a proper balance between such personnel and other categories of trained manpower. First of all, one would like to see aid directed towards the development of sound systems of general secondary education, with curricula providing for good technical and science teaching. One would welcome a substantial increase in the proportion of technical teachers who are supplied to African countries under various assistance schemes as well as inducements to specialists with scientific and technical qualifications to provide part-time teaching for local technical institutes.

29 Increasing use ought also to be made of the technique of 'attachment' for on-the-job training and technical experience for African personnel in agricultural, industrial and commercial establishments. Aid in this case might take the form of travel grants and of firm arrangements with Commonwealth companies operating in developing member countries by which they systematically assist with the education and training of indigenous personnel. In this category one would also put the need to develop on-the-spot training courses for the essential cadres of middle-level public enterprise, with the object of widening the trainees' work experience and technical competence.

30 This is by no means an exhaustive list of needs towards which educational aid from abroad might be directed; it is more of a sketch of those areas which are of critical importance to national development programmes.

Multi-national programming

31 The United Nations has taken note of the fact that the human resources of developing countries represent one of their major resources in the struggle to ameliorate the conditions of life of their peoples. Specifically, a recent resolution of the Economic and Social Council underlines the need for intensified training of national personnel and for concerted action by international

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[1] LEWIS, W. A. Aspects of Economic Development. African Conference on Progress through Co-operation, Kampala, 1965. (Mimeographed) p. 10.

organisations to this end.[1] The resolution calls in particular for collective efforts to:

> 'undertake a comprehensive analysis of the need for trained manpower in the developing countries, involving projections of these needs into the future, and to formulate a stepped-up, long-range programme of concerted action on the basis of this survey; to select certain outstanding problems and bottlenecks that are commonly encountered by international organisations in their work in the training field, and to formulate concerted action programmes to deal with problems such as the brain drain from developing to developed countries; the problem of location of training; the lack of research support in the application of technical training to the particular conditions of the developing countries; lack of materials for training; language problems in the dissemination of knowledge, etc.'

32 This international call for concerted action and for a multilateral approach to the problems of aiding developing countries build up their body of trained personnel certainly merits the attention of members of the Commonwealth. As an association of states in which more than three-quarters of the members are in the process of rapid economic development and most older members are major donors of foreign aid, the Commonwealth is uniquely well placed as an instrument for promoting a high degree of multilateralism in the distribution and in the use of aid.

33 While, in the normal way, any attempts to create consortia of donor countries is beset by the pitfalls of cultural and political differences, as well as differences of educational systems, among others, the Commonwealth association has the advantage of size, a certain community of experience and culture, and is therefore free from most of the difficulties which inhibit international co-operation in aid.

34 In the African region, ECA has taken the initiative in encouraging governments to look beyond national frontiers, to tackle the difficult problem of harmonising their development programmes and policies, and to see the advantages of developing specialised institutions on a multi-national basis for the training of skilled personnel. The long-term goal of the Commission is African co-operation in the economic, the social, and the educational fields, through the establishment of regional and sub-regional institutions for financial, economic, and educational ends. Upon this basis of inter-African self-help, we feel that we can confidently look to friendly countries within the Commonwealth, in the United Nations family, and in other international organisations, to give the additional help that is still badly needed.

35 Now, what role could the Commonwealth play in this search for greater rationalisation of aid? Specifically, I would suggest that consideration might be given to the establishment of a Commonwealth Committee for the Co-ordination of Education Aid as well as of a Commonwealth Education Fund for Developing Countries. Such a fund could be sustained by contributions from the individual aid programmes of the more developed Commonwealth members. The fund would give priority in awarding grants to educational projects in developing countries which require multilateral assistance, such

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[1] UNITED NATIONS, Administrative Committee on Co-ordination, Sub-Committee on Education and Training, Co-ordination/ET/R.35 of 4 November, 1965.

as projects involving more than one recipient country, research, assistance with student exchange for technical experience, and scholarships in strategic fields of study at undergraduate level in the new African universities.

36 The following might be the main foci of Commonwealth aid to the African region:

(1) The establishment, development or support of some regional institutions and research centres in agriculture, industry and education.

(2) Promotion of third-country aid programmes for training in specialised priority fields.

(3) Co-ordination of private aid programmes directed to education and training.

(4) Provision of a consortium service for financing and aiding specific educational projects such as the supply of technical teachers, of equipment, and of teaching aids for technical education.

(5) Reviewing Commonwealth scholarship programmes with the aim of relating awards of such scholarships to areas in which developing countries most need trained personnel.

(6) Harmonising policies and attitudes towards what is known as 'brain drain', particularly as regards technical manpower from developing countries, and exchanging information on practical measures for encouraging the return of these skilled people to their home countries.

37 It is evident that the needs of developing countries in the field of technical education as well as in other areas where resources must be mobilised and developed, are very great indeed. No one generous donor country can either find the definitive solution or bear the whole economic burden. As the developing countries themselves become more experienced and gain direct knowledge of their own problems, so they become more aware of the potential importance of co-operative programmes of assistance.

38 The need of the moment is for a higher order of collective action. An association such as the Commonwealth, whose membership runs the whole gamut from highly advanced and industrialised countries to underdeveloped countries, is ideally suited to make a major contribution towards solving this fundamental problem of the distribution and use of technical assistance to education.

APPENDIX

The Development of Technical and Vocational Training in Africa[1]

The Need for Technical Training

1 African traditional economies and cultures were not conducive to the early evolution of technical training. There is therefore no mechanical tradition or long-standing familiarity with tools and modern technical terms. The pressing demand for skilled workers is a recent, post-war development.

2 In the inter-war years low world commodity prices hampered economic development in Africa, consequently limiting the demand for mechanical equipment of all kinds and for the technical skills required to service them. Such demand as did exist for skilled personnel was frequently supplied by European and Asian craftsmen. Although a technical school was established in Accra (Ghana) as early as 1909, local demand for craftsmen was too small to justify training large numbers of skilled indigenous workers. There were trade schools in a number of territories, but their output was small and the demand for personnel with technical training was not large enough to induce the governments to envisage large-scale expansion of the facilities.

3 In the post-war years rising imports of mechanical equipment, motor vehicles and electrical appliances of all types, generated by the prosperity resulting from high produce prices, led to increased demand for craftsmen and technicians. This demand was further stimulated by large-scale building and construction work resulting from the implementation of national development plans. This increase in demand for technical skills stimulated an expansion in the supply of skilled men. The policy of 'Africanisation' adopted by both government and private enterprises, could be realised only by extensive training programmes for Africans; this, too, gave a fillip to local production of technicians and craftsmen.

4 Almost simultaneously, the supply of overseas technicians began to diminish as their services came to command a premium in their own countries. However, with economic development giving new opportunities to Africans with technical skills, the proportion of Africans with skilled and semi-skilled qualifications gradually rose.

5 Recent trends in the demand for technicians and craftsmen indicate growing shortages of skilled men both for the servicing of consumer-type mechanical equipment and in industrial production. As new consumption patterns are established, new industrial projects undertaken and new services provided, the demand for skilled men will grow in numbers and skill variety. Any attempt to estimate the future demand for men of the right type therefore must be based on a comprehensive analysis of the course of the continent's future economic

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[1] This review is based largely on material drawn from an article entitled 'Aspects of Technical and Vocational Training in West and East Africa' in United Africa Company Limited Statistical and Economic Review, No. 22, January 1959.

development. But planning techniques have only recently begun to be understood and applied in most African countries. Consequently, no such analysis and no forward planning of their training have been undertaken. As a result, the development of technical education and training has failed to keep step with the demand for skills.

African Aptitude for and Attitudes to Technical Training

6 The relative backwardness of technical education in Africa has also been attributed to a relative lack of interest on the part of Africans in technical training and manual work. On the other hand, the enthusiasm of Africans of all ages for education in general is universally recognised. Education has traditionally opened the way to higher paid jobs, social prestige, and leadership. However, since 'education' in this context meant exclusively 'academic' training, leading to 'white-collar' jobs, technical education has been held in comparatively low esteem and many Africans have come to equate work with one's hands with social inferiority. The real worth of technical education in a modern society where machines play a preponderant role has been, generally speaking, imperfectly appreciated by the African student.

7 Africa's socio-economic conditions have affected the development of the right attitudes to, and the necessary aptitude for, technical education. Various investigations which have been conducted with the aim of discovering whether Africans suffer from any innate disadvantages in the acquisition of technical skills have been inconclusive. Such lack of aptitude for technical occupations—when compared with people from industrialised countries—as has been established can be attributed not to innate capacity but to cultural factors and traditional economies, which neither require nor foster the mental attributes needed for successful engagement in a modern economy.[1] The main factors in an African's background which hinder the development of interest in, and capacity for technical occupations are his want of familiarity with modern tools, industrial equipment and gadgets, mechanical toys, and technical terms which, by contrast, are part of the everyday experience of children in industrialised societies.

8 The African's relative lack of interest in manual work can be partly ascribed to the comparative absence of material and psychological incentives for creating a proper sense of the value of manual work and technical operations. Promotion prospects, larger pay packets, occupational prestige, subsidies, and prerequisites attached to posts in public employment have been, on the whole, more generously available to clerical and administrative personnel than to technicians and professionals.

Coping with the Need

9 As the demand for skilled and semi-skilled personnel has grown, both public and private employers have been compelled to import more foreign technicians and craftsmen or to train local ones. Although general education and technical training have generally been regarded as the normal responsibility of government and voluntary organisations, the rate at which demand for trained personnel has

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[1] COMMISSION FOR TECHNICAL CO-OPERATION IN AFRICA SOUTH OF THE SAHARA, (now OAU/STRC). Human Factors of Productivity in Africa—a Preliminary Survey, London, 1956. Also chapter III, 2nd ed, 1960.

risen over the past two decades has induced private employers, in their own interests, to provide training on an ever-increasing scale for their workers.

10 Various schemes for technical education and training launched by private and public agencies are summarised below:

(a) *Governmental Institutes*

11 In Commonwealth Africa five different types of State-financed and publicly administered institutions for technical education and vocational training have evolved for local training of skilled personnel.

(i) Handicraft Centres
(ii) Trade Centres or Schools
(iii) Secondary Technical Schools
(iv) Technical Colleges or Institutes
(v) Universities and Colleges of Technology

(i) Handicraft or Vocational Training Centres, also known as Craft Schools, were established to train semi-skilled workers. In some territories these centres provide facilities for training adolescents and adults in specific trades such as carpentry, motor fitting, metal work, weaving, pottery, shoemaking, etc., while in others they provide vocational training for primary school leavers.

(ii) Trade Centres turn out craftsmen skilled in one basic trade. The length of courses varies according to the trade, ranging from two to three years for painters and decorators to five years for fitter machinists, electricians, motor mechanics, etc. Standards of performance are ensured by appropriate government trade tests at the end of training.

(iii) Secondary Technical Schools are few in Commonwealth Africa, almost all secondary schools being of the grammar school type. However, as early as 1909 the Government Secondary Technical School, Takoradi (Ghana), was established as an institution combining grammar school education with courses in mechanical engineering and building.[1] In Nigeria, Kenya, and Uganda, secondary technical courses became available in a few schools during the post-war years. These schools combine general education with technical education leading to the intermediate City and Guilds examinations, or local equivalents.

(iv) The need for sub-professional skilled personnel has led to the establishment of Technical Institutes providing training courses of 3–4 years duration for students on engineering and the building trades. Trainees are prepared for the appropriate examinations of the City and Guilds of London Institute, the West African Technological Certificate, or their equivalents, and, in the case of commercial students, for the examinations of the Royal Society of Arts. One or two-year student apprenticeships in private industry or in a government technical department are necessary qualifications for the post of technical assistant.

(v) University Colleges and Colleges of Technology offering advanced technical courses are a more recent development for full professional education in accountancy, commerce, pharmacy, architecture, surveying, estate management, mechanical, civil and electrical engineering, etc. In this category of institutions belong the various African universities and university colleges offering technical courses, as well as the Colleges of Technology.

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[1] Ghana Today, 22 January 1958. Ghana High Commission, London.

(b) *Government Departments and Public Corporations*

12 In order to cope with their growing requirements for skilled personnel and later to foster Africanisation in their establishments, government technical departments and public corporations have provided facilities for specialised training within their respective organisations. These facilities have taken such forms as departmental schools, training workshops, on-the-job training, orientation courses, pre-service training and scholarships for training through academic studies, technical training, and 'experience attachment' abroad.

13 In the Commonwealth African States, for example, Departments or Ministries of Agriculture, Public Works, Post and Telegraphs, Railways, and Broadcasting Services have traditionally provided technical training for their employees. Training programmes for technical personnel have reached a higher level of rationalisation and co-ordination in the East African countries as a result of the activities of the East African Common Services Organisation, particularly in the activities of the East African Railways and Harbours Administration and the Post and Telegraphs Administration. In Ghana and Nigeria public corporations with responsibility for broadcasting, ports and harbours, railways, electricity, etc., have worked out extensive internal training schemes for their employees.

(c) *Private Enterprise*

14 Although general education and vocational training are generally assumed to be the responsibility of government, the history of education in Africa reveals that private enterprise has in the past played and still plays a significant role. Previously this private participation was primarily the contribution of missionary organisations. In the post-war years, however, profit-making private enterprises have increasingly provided training schemes for their workers to meet their own needs for adequate numbers of trained personnel.

15 Private business firms have initiated a variety of training schemes in order to ensure that their workers, particularly the local recruits, reach the high standard of proficiency required for operations in their technical departments. For firms selling technical equipment, the need to provide after-sales service has obliged them to develop crops of technically proficient workers.

16 Over the years the number of firms providing substantial technical training for their employees has grown steadily, and these now include the leading commercial, mining, oil, transport, and banking companies. A variety of training schemes has been launched, ranging from on-the-job training to private trade schools. The main types of training schemes commonly provided by private employers are the following:

(i) *Indentured Apprenticeship.* This provides trainees with a training period of 2–5 years of indentured service, at the end of which, in well-established firms, apprentices are issued with the company's Certificate of Proficiency in a given trade. Training in this case is usually done in the company's training school or workshop and, in the less established firms, on the job.

(ii) *Training on the Job.* Most firms give their employees such on-the-job technical training as is necessary to ensure familiarity with production techniques and a degree of proficiency in job performance. Such training is usually provided at different levels: pre-service, induction, in-service, assignment to new tasks, introduction of new techniques, etc. Graduates of trade and technical schools also receive some informal training and in some cases further intensive training on the job. A number of leading firms have adopted the principle of Training Within Industry in providing advanced technical training for supervisory staff. This form of training is based on an analysis of the essential skills and technical know-how a supervisor should possess in order to operate effectively and efficiently, and endeavours to develop these skills through job instruction, job relations and job methods.

(iii) *Company Trade Schools.* Many of the larger private employers have developed their own trade schools, offering full or part-time training of varying durations for their apprentices and trainee employees, usually tailored to the technical skill requirements of the firms sponsoring them.

(iv) *Overseas Training.* Where private companies' skill requirements could not be met locally either from public institutions or by their own establishments, training facilities in advanced countries, usually in the home countries of foreign firms, have frequently been used to train Africans. Such training is usually provided in the Staff Colleges and establishments of the parent firms, with emphasis on on-the-job training and familiarity with the latest techniques. According to the needs of employers and local recruitment possibilities, offers of overseas training have occasionally been made to technical personnel at the middle level; but the most common recipients are senior level staff and persons showing the greatest potential for assuming higher responsibilities.

(v) *Miscellaneous training schemes*, ranging from refresher courses for familiarisation with new techniques to job-oriented short courses for operatives such as comptometer operators and salesmen in technical departments, are frequently organised.

17 Private training schemes have enabled the leading private companies, particularly foreign firms, to be more or less independent of public educational and training institutions for the greater part of their requirements of technical personnel. On the other hand, the less established firms, particularly the indigenous ones, have not been able to develop such self-reliance. Since the products of public institutions have been inadequate in numbers and skill variety to meet the needs of all employers, the small employers have had to operate with less technically qualified workers.

Implementation of Technical Training Programmes

18 The two principal handicaps to the implementation of intensive training programmes for technical personnel in Africa have been the *shortage of qualified instructors* and *shortage of funds*. It could be argued that where adequate funds are assured, institutional facilities in the form of buildings, technical textbooks, visual aids and workshop equipment could readily be provided. However, the same would not apply insofar as the shortage of instructors is concerned, because indigenous instructors of the desired technical competence are scarce and the demand for qualified foreign instructors far exceeds the supply. It is a well-known fact that owing to the world-wide shortage of qualified instructors many technical colleges and trade schools in Africa suffer from acute staff shortages and experience great difficulties in recruiting suitably qualified teaching personnel. Consequently, expansion in trainee and student intake as well as the introduction of new training courses in both private and public training institutions and establishments have been severely limited.

The Cost of Training

19 Education and training, whether provided by the State or by private employers, are expensive undertakings. In many African States public expenditure on education, on both capital and current accounts, has taken as much as one-quarter or more of the total public outlay on all services and development projects. On the average, the Commonwealth countries of East and West Africa spent about 15 per cent of their combined recurrent and capital expenditure in 1958/59 on education. This outlay worked out at £0·8 per capita. By contrast, in the United Kingdom the central government and local authorities spent in 1957 some 11 per cent of their combined current and capital expenditure or £15·5 per capita on education.[1]

20 Thus, although in absolute terms the Governments of Commonwealth Africa are spending on education only about one-twentieth of what is spent by the United Kingdom, their expenditure represents a far larger proportion of their annual budgets and of resources available for development.

21 General education is the foundation for technical training. Unfortunately, separate data for technical training are rarely comprehensively indicated in government budgets. However, United Kingdom grants for education in Commonwealth Africa under the Colonial Development and Welfare Acts between 1954 and 1958 show that the bulk of these resources was devoted to primary, secondary, and higher education, excluding technical education and vocational training. Of the nearly £15 million thus allocated, less than one-quarter was allocated for technical and vocational training; and when the grants to Colleges of Technology are added, the total share of technical education at all levels was still no more than two-fifths of the total allocation to education.

22 The cost of technical training provided by private employers has varied according to the scale of the training schemes they operated. Outlays on such schemes have generally been highest among firms providing private residential technical schools, comprehensive in-service training, including overseas training, and lowest among those depending largely on on-the-job training. In the case of the leading industrial, mining, commercial and oil companies the expenditure on a trainee in a private school has been estimated at £200–300 per annum, and for an apprentice period of five years a total outlay of up to £1,500 per trainee may be incurred.

23 Direct investment in private trade schools and in training schemes of all kinds for workers represents only one part of the contributions of private firms to the technical training of Africans. Many private firms and foundations have made educational gifts, usually in the form of financial grants and educational equipment, to African governments or institutions to enable them to expand training facilities.

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[1] **UAC Statistical and Economic Review.** ***op. cit.***

24 Furthermore, bilateral and multilateral organisations such as the United Nations and the technical assistance agencies of many developed countries have assisted African countries through fellowships, scholarships, financial grants and the supply of technical teaching personnel and material, in carrying the burden of providing technical training for Africans.

Conclusions

25 The preceding survey has attempted to give a summary picture of the development of technical and vocational education in Africa in direct response to the growing demand for craftsmen and technicians. In this development the task of providing training facilities has not been left to governments alone; rather, private employers, motivated, reasonably enough, by self-interest, have made substantial contributions.

26 Much has been achieved in Africa towards relating the type and the length of technical training to the skill requirements for job performance. In the former French and Belgian territories trade centres have expanded rapidly, offering training facilities to relatively larger numbers of Africans than has been the case in the territories of English expression. These centres have given Africans courses of 8–9 months of practical training, followed by six-month periods of on-the-job industrial training. Those tailored-to-need courses have suitably adapted trainees to their trades and are reputed to have been a great success in terms of training for development.

27 Technical education and training in Africa, particularly the contributions of private employers, have been largely oriented towards meeting the skill requirements of commerce, mining, transportation, and industry. By contrast, relatively little has been done to build up adequate corps of technical personnel for the application of modern science and technology to agriculture and allied industries. Agriculture, no less than commerce and industry, needs skilled technicians in large numbers in order to achieve the rapid structural transformation that is necessary. This is particularly important for Africa's overall economic advancement, as agriculture will for a long time continue to be the main source of prosperity for the people.

28 The provision of educational facilities has caused and continues to cause severe strains on Africa's public budgets. Yet the demand for education and particularly academic education remains practically insatiable. Devoting increased resources towards meeting the educational demand may accentuate the possible danger of securing educational advancement at the expense of economic development. It is therefore desirable that increased emphasis should be placed on technical education and training for development and that government expenditure patterns should be increasingly influenced by the need to seek a judicious balance between social objectives and economic goals.

Discussion in Plenary Session

Mr. Edokpayi explained that the paper which he was introducing had been prepared in direct relation to the African context but, with suitable adjustments, it was equally applicable to other developing areas. There is a wide variety of aid patterns. A certain amount of aid is provided by developing countries themselves for less fortunate neighbours; consortia have been established for major aid projects in some countries; but the predominant form, accounting for some 75 per cent of all aid, is bilateral aid which to a very considerable extent is influenced by cultural and historical ties. Thus Belgian aid is provided in Central Africa, French aid goes mainly to the French-speaking countries, American aid goes mainly to South-East Asia, sub-Saharan African, and Latin America, and two-thirds of the total aid received by Commonwealth countries has come from Britain. During the period 1946–62, approximately 20 per cent of the aid made available through Colonial Development and Welfare Funds went on education, made up as to 9 per cent on secondary education, 7 per cent on higher education and only 3 per cent on technical education.

It was stated that aid is too often tied in one form or another and that there is a lack of multi-national or regional projects which will foster and encourage regional co-operation. In Africa, the need is for teachers and scientists and for technical teachers; there will be a growing shortage of skilled persons in Africa during the next ten to fifteen years, and this lack of middle-level personnel is a real bottleneck to development. UNECA takes a multi-national approach to development and advocates the establishment of projects on a regional or sub-regional basis: in order to support this type of development, new institutions are needed and the proposals made in the paper for a Commonwealth Committee to co-ordinate educational aid, and for a Commonwealth fund for education were an attempt to meet this need. Analysis of the Commonwealth Scholarship and Fellowship Plan showed that few awards went to the less-developed countries for purposes directly related to skilled manpower. The proposed Commonwealth education fund would be able to support research projects, the development of advanced technical colleges or technological universities and the provision of training directly relevant to Africa's needs.

Mention was made of the Organisation for Economic Co-operation and Development, to which twenty-one developed nations belong, and of the high priority given to education in general and to science and technical education, as the most wealth-producing forms of education, in particular. OECD provides joint aid for developing countries and considers middle-level personnel to be very important as potential wealth producers. Research work has shown the value of systematic career studies, and job analysis surveys are considered very important.

The difficulties of administering educational assistance from Canada, due to the absence of a federal education agency, were pointed out but, despite this, aid for education is a growing part of Canadian aid programmes, and the West Indies and Africa (French and English speaking) are being given assistance. The main forms of aid are the supply of science and mathematics teachers.

It was explained how the efforts of FAO are concentrated on helping developing countries to work out and set up plans which can then be taken over by bilateral forms of aid. Experts are also provided to work up requests to the United Nations Development Programme. Conferences are convened in developing countries to consider their problems, and equipment, experts and fellowships provided on a pump-priming basis with the projects eventually being taken over by the recipient governments.

Reference was made to the great efforts being made by ILO in the field of technician education. The main emphasis is placed on the training of supervisors and technicians, and there are currently over forty missions in developing countries.

It was explained that the Ford Foundation concentrated on the planning of economic development which leads in turn to educational planning and this in turn to the building of institutions.

In a discussion on the provision of experts, equipment and fellowships, it was pointed out that some countries would not provide equipment without the provision of experts. It was questioned whether this is right, especially in the case of countries having the manpower but lacking the equipment for them to use.

The view was expressed that bilateral aid may not be a bad form of organisation, and that there may be no particular dangers in aid following cultural and historical ties. In this context the need for new machinery to co-ordinate the provision of aid was questioned, and it was suggested that informal co-operation between institutions in metropolitan countries and in developing countries offers one of the best means of development in the field of technical education.

APPENDIX I

Delegates and Observers at the Commonwealth Conference on the Education and Training of Technicians

Chairman	Dr. G. E. Watts
Guest Speakers (Plenary Sessions)	Shri L. S. Chandrakant (India) Dr. H. W. French (Britain) Mr. R. E. Dunbar (Australia) Mr. A. MacLennan (Britain) Dr. J. T. Young (Britain) Mr. J. W. Gailer (Britain) Mr. J. C. Jones (Britain) Mr. S. Edokpayi (UNECA) presented a paper on behalf of Mr. R. K. A. Gardiner (UNECA)
Guest Speaker (Closing Session)	Sir Willis Jackson, F.R.S. (Britain) (*now* Lord Jackson of Burnley)

National Delegations

Australia

Mr. J. L. Kepert	Director of Technical Education, Victoria
Mr. M. H. Bone	Director of Technical Education, South Australia
Mr. R. E. Dunbar	Director, Department of Technical Education, N.S.W.
Mr. N. R. Edwards	Education Liaison Officer, Australia High Commission, London
Mr. G. Stoker	State Supervisor of Engineering Courses, N.S.W.

Britain

Ministry of Overseas Development

Mr. A. R. Thomas
Mr. F. Dunnill
Sir Christopher Cox
Mr. W. G. Wormal
Mr. J. C. Jones
Mr. J. W. Gailer
Mr. D. A. Thain
Mr. W. Hobman

Council for Technical Education and Training for Overseas Countries

Mr. H. M. Collins
Miss D. A. Long
Mr. V. H. Moult
Miss J. Pearson

Britain (contd.)

Department of Education and Science

Dr. H. W. French
Mr. H. Jordan
Miss K. M. Tobin
Mr. E. Houghton

Ministry of Labour

Mr. F. Perkins
Mr. D. McDermott
Miss A. Roberts
Mr. A. K. Corry
Mr. J. S. Child
Mr. A. Turner

Non-Departmental

Dr. J. E. Richardson	The Polytechnic, Regent Street, London
Dr. O. G. Pickard	Ealing Technical College, London
Mr. D. B. Bartlett	Chief Education Officer, Southend-on-Sea
Mr. J. R. Moore	Bradford Technical College
Mr. A. MacLennan	Huddersfield College of Education (Technical)
Dr. J. T. Young	Chance Technical College, Warley
Mr. W. E. Buckley	Blackburn Technical College
Mr. L. C. J. Gilling	Yorkshire (WR) Institute of Agriculture, Askham Bryan
Mr. F. A. Wheeler	Royal Society of Arts
Dr. J. Leese	Yorkshire Council for Further Education
Major-General Cyril Lloyd	City and Guilds of London Institute
Mr. D. E. Wheatley	
Mr. B. H. Henson	
Mr. R. H. Fox	
Mr. G. R. P. Henton	
Mr. J. H. Tomson	
Mr. J. P. Twining	
Mr. W. M. Macqueen	Liverpool College of Building
Mrs. Felicity Bolton	Council for Education in the Commonwealth, House of Commons, London
Mr. B. C. Lucia	Associated Examining Board
Mr. J. Lee	Council of Engineering Institutions
Mr. J. Lloyd	Engineering Industry Training Board, Leeds
Mr. J. B. Firth	
Mr. R. Carling	Engineering Industry Training Board, London
Mr. R. E. Stevenson	
Mr. R. Sumption	
Mr. D. G. Chisman	Centre for Curriculum Renewal and Educational Development Overseas

Scotland	
Mr. L. Pendleton	H.M. Inspector, Scottish Education Department, Edinburgh
Miss E. I. Young	36 Broadstone Park, Inverness
Mr. A. W. Chisholm	Principal, Clydesbank Technical College, Glasgow
Mr. J. F. Walker	Secretary, Scottish Association for National Certificates and Diplomas, Glasgow
Mr. F. Inglis	Regional Officer, Engineering Industry Training Board, Glasgow
Northern Ireland	
Mr. R. A. Zachary	Ministry of Education, Belfast
Mr. T. E. Goligher	College of Technology, Belfast
British Territories	
Bahamas	
Mr. W. E. Saul	Principal, Nassau Technical Institute
British Honduras	
Mr. C. E. Gillett	Vice-Principal, Belize Technical College
Hong Kong	
Mr. C. T. Kell	Assistant Director (Further and Technical Education), Hong Kong
Mr. S. Z. Sung	Principal, Technical College, Kowloon
Mauritius	
Mr. D. Burrenchobay	Permanent Secretary, Ministry of Education and Cultural Affairs
Canada	
Dr. C. R. Ford	Technical Training Consultant, Technical and Vocational Training Branch, Department of Manpower and Immigration, Ottawa, Ontario
Dr. W. G. Hines	General Supervising Metallurgist, Steel Company of Canada, Hamilton, Ontario
Mr. H. J. Hodder	Director of Education, External Aid, Department of External Affairs, Ottawa, Ontario
Mr. P. E. Larose	Director-General of Technical and Vocational Education, Quebec
Mr. E. L. Palin	Assistant Director, Applied Arts and Technology Branch, Department of Education, Ontario

Ceylon	
Dr. S. L. de Silva	Deputy Director-General, Department of Education, Colombo
Cyprus	
Mr. G. C. Economides	Principal, Polis Technical College
Mr. S. T. Theocharides	Director, Cyprus Productivity Centre, Nicosia
Ghana	
Mr. J. G. O. Torto	Chief Technical Education Officer, Accra
Mr. C. A. Dadey	Principal Secretary, Ministry of Agriculture, Accra
Mr. S. F. Kwaku	Engineer-in-Charge (maintenance) PWD, Deputy Engineer-in-Chief, Accra
Mr. D. J. Nyarko	Principal, Teachers College, Kumasi
Guyana	
Mr. C. Pooran	Principal, Georgetown Technical Institute
India	
Prof. A. C. Roy	Vice-Chancellor, North Bengal University, Darjeeling
Mr. A. B. Chandiramani	Joint Educational Adviser (Tech.), New Delhi
Mr. A. P. Jambulingam	Principal, Southern Regional Institute for Training of Technical Teachers, Madras
Jamaica	
Mr. C. Wint	Principal, College of Arts, Science and Technology, Kingston
Kenya	
Mr. J. A. Benyon	Senior Education Officer, Ministry of Education, Nairobi
Malawi	
Mr. K. P. Storer	Chief Education Officer, Ministry of Education, Zomba
Mr. L. P. Anthony	Assistant Chief Education Officer, Ministry of Education, Zomba
Mr. C. J. Leven	Senior Education Officer, Ministry of Education, Zomba
Mr. L. B. Mallunga	Assistant Chief Inspector of Schools, Ministry of Education, Limbe
Malaysia	
Mr. Arshad Ayub	Principal, Mara College of Business and Professional Studies, Petaling Jaya, Selangor

Malaysia (contd.)	
Mr. Ng Chin Hong	Director, Malaysian Students Department, London
Mr. J. A. Richards	Assistant Adviser Technical Education, Kuala Lumpur
Mr. Ahmad Yunus	Administrator, Agricultural Education and Training Branch, Division of Agriculture, Ministry of Agriculture and Co-operatives, Kuala Lumpur
Malta	
Mr. A. Raimondo	Headmaster, Technical Institute
Mr. C. Cuschieri	Headmaster, Secondary Technical Schools. President, Malta Society of Arts, Manufactures and Commerce
New Zealand	
Dr. B. C. Lee	Director of Technical Education, Wellington
(also representing the Government of Western Somoa)	
Mr. B. W. Potter	Principal, Wellington Polytechnic
Nigeria	
Mr. I. I. Inwang	Acting Principal, Yaba College of Technology, Lagos
Mr. Okwuese Ozoro	Acting Chief Technical Education Officer, Ministry of Education, Western Region, Ibadan
Mr. H. S. Wali	Principal Education Officer, Ministry of Education, Northern Region, Kaduna
Mr. D. J. Williams	Principal, Enugu Technical College, Enugu
Pakistan	
Mr. I. A. Shah	Director, Technical Education, Lahore, West Pakistan
Singapore	
Mr. N. K. Vanniasingham	Deputy Secretary to the Ministry of Education, Singapore
Tanzania	
Mr. D. F. Martin (*Observer*)	Principal, Dar-es-Salaam Technical College and Adviser on Technical Education
Mr. M. B. Belcher (*Observer*)	Head of Electrical Engineering Department, Dar-es-Salaam Technical College
Trinidad and Tobago	
Mr. N. J. Masson	Principal, John S. Donaldson Technical Institute, Port-of-Spain, Trinidad
Mr. V. A. Richardson	Lecturer, Faculty of Engineering, University of the West Indies, Trinidad

Uganda

Mr. B. P. Kiwanuka	Chief Inspector of Schools, Ministry of Education, Kampala
Mr. R. Dronyi	Senior Executive Engineer, Ministry of Works, Entebbe
Mr. G. H. Walwyn	Principal, Uganda Technical College, Kampala

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Mr. A. L. Adu	Deputy Secretary-General
Dr. H. W. Springer	Director, Commonwealth Education Liaison Unit
Mr. G. Hensley	Special Assistant

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Mr. K. N. Johry	India High Commission, London
Mr. I. Jimeta	Nigeria High Commission, London
Mr. Rafiq Ahmad	Pakistan High Commission, London
Mr. S. M. Sepeku	Tanzania High Commission, London
Mrs. L. S. Dorset	Trinidad and Tobago High Commission, London
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Commonwealth Foundation

Mr. R. N. Dawson (*Observer*)	Administration Officer

International Organisations and Foundations

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Dr. A. L. Mathieu (*Observer*)	Agricultural Education Adviser, FAO, Rome, Italy
Mr. S. J. G. Burt (*Observer*)	Deputy Assistant Director, IBRD, Washington, DC, USA
Mr. K. D. Luke (*Observer*)	UN Development Programme, New York, USA
Mr. P. H. Quallo (*Observer*)	Vocational Training Branch, ILO, Geneva, Switzerland
Mr. L. Ter-Davtian (*Observer*)	Directorate for Scientific Affairs, OECD, Paris, France
Dr. K. N. Rao (*Observer*)	Associate Director, Overseas Development Programme, Ford Foundation, New York, USA

International Organisations and Foundations (contd.)

Dr. J. C. Warner (*Observer*)	Consultant to Ford Foundation on Education, New York, USA

Secretariat

Mr. L. M. Graham	Deputy Director, Commonwealth Education Liaison Unit, London
Mr. W. Hobman	Ministry of Overseas Development, London
Mr. J. M. Scoular	Commonwealth Education Liaison Unit, London
Mr. K. Wilburn	Huddersfield College of Education (Technical)
Mr. B. Coombs	
Mrs. A. Wilson	Commonwealth Education Liaison Unit, London
Miss H. M. Cockett	
Miss J. Procter	
Mrs. M. Seelig	

Recorders

Huddersfield College of Education (Technical)

- Mr. F. Barr
- Mr. J. Blackshaw
- Miss D. Comley
- Mr. J. C. Davies
- Mr. J. Flinn
- Mr. P. B. Frankland
- Mr. W. H. Green
- Mr. J. Hall
- Mr. A. Odams
- Mr. J. Pratt
- Mr. P. Saunders
- Mr. W. G. Sparrow
- Mr. J. F. Topping

Organiser of Demonstration of Teaching Aids and Equipment

Mr. B. S. Alloway	Huddersfield College of Education (Technical)

APPENDIX II

List of other Papers contributed by Governments and other Organisations

Note: The Commonwealth Secretariat has limited supplies of these papers at its offices in Marlborough House, Pall Mall, London S.W.1. Copies may be obtained on request from the Education Division of the Secretariat at this address.

Reference No.	*Subject*	*Contributor*
CETT (P) 1/2	Plans for development of technical education with special reference to Ceylon	Ceylon
CETT (P) 1/3	Providing scarce middle-level manpower for developing countries	Britain
CETT (P) 1/4	Manpower aspects of technicians and other middle-level training	India
CETT (P) 1/5	Certification of technicians in Canada	Canada
CETT (P) 1/6	Education of technicians	Nigeria
CETT (P) 1/7	Technical education and training of special interest to women and girls	Britain
CETT (P) 1/8	The supply of and demand for technicians	Britain (Ministry of Labour)
CETT (P) 2/2	Education of technicians by correspondence in New Zealand	New Zealand
CETT (P) 2/3	Education and training of technicians by correspondence in Australia	Australia
CETT (P) 2/4	The content of training courses	Australia
CETT (P) 2/5	Types, content and organisation of technician education and training	Britain (City and Guilds of London Institute)
CETT (P) 2/8	The development of courses and examinations	New Zealand
CETT (P) 2/10	The place of technician training in the educational systems	India
CETT (P) 2/11	Types, content and organisation of training	India

Reference No.	*Subject*	*Contributor*
CETT (P) 2/12	Curriculum development	Canada
CETT (P) 3/2	Planning an institution	Britain
CETT (P) 4/2	The supply and preparation of teachers for technician courses	Australia
CETT (P) 4/3	Steps taken and needed to be taken to meet the shortage of technical teachers with special reference to Ceylon	Ceylon
CETT (P) 4/4	Recruitment and uses of expatriate staff	Britain (TETOC)
CETT (P) 4/5	General course in science teaching project	Britain (Huddersfield College of Education (Technical))
CETT (P) 5/2	Entrance requirements and selection for technician education and training and the evaluation and recognition of standards of attainment	Britain (City and Guilds of London Institute)
CETT (P) 7/2	Assessment of the present and planned provision for the education and training of technicians in Commonwealth countries	Britain (City and Guilds of London Institute)
CETT (P) 7/4	Technician training as an aspect of Canadian aid	Canada
CETT (P) 7/5	Financial assistance to technical education	International Bank for Reconstruction and Development
CETT (P) 7/6	Technicians in Western Samoa	Western Samoa

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COMMONWEALTH EDUCATION
LIAISON COMMITTEE

Education and Training of Technicians

Report of an Expert Conference held at the College of Education (Technical), Huddersfield, England October 1966

LONDON
HER MAJESTY'S STATIONERY OFFICE
1967

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Foreword

By: Mr. H. L. Elvin

Chairman of the Commonwealth Education Liaison Committee

I am very pleased to have the opportunity to commend this report to the Governments of the Commonwealth countries and to all those educationists and industrialists who are concerned with the problems of the education and training of technicians. The report indicates the willingness with which representatives of Commonwealth countries are prepared to exchange ideas and information on matters of vital concern and direct relevance to their economic and sociological development.

While the so-called developing countries face many special problems, many of the matters discussed at the Conference are of equal importance to all nations irrespective of the degree of their economic development. All recognise the important place occupied by the training of technicians in any attempt to plan the most effective use of human resources, and all are eager to learn from the knowledge and experience of others. The Conference has given an opportunity to Commonwealth countries to exchange such knowledge and experience to their mutual benefit.

The Commonwealth Education Liaison Committee wishes to thank the British Government for the invitation to hold the Conference in Britain, and the Huddersfield Education Authority for its co-operation in arranging for the Conference to be held at the Huddersfield College of Education (Technical).

I now invite our associates in the Commonwealth who are concerned with these matters to consider this report at the Commonwealth Education Conference. It is sincerely hoped that the member countries of the Commonwealth will be able to examine, evaluate and, where appropriate, act upon the suggestions that are made in this report. It is clear that certain of the suggestions made at the Conference were only thought to be relevant in particular circumstances. It is felt, however, that all countries, whatever their specific problems, will benefit from a study of the ideas put forward at the Conference and contained in this report.

LETTER FROM THE CHAIRMAN OF THE CONFERENCE TO THE CHAIRMAN OF THE COMMONWEALTH EDUCATION LIAISON COMMITTEE

Sir,

I have much pleasure in submitting to the Commonwealth Education Liaison Committee the report of the Conference on the Education and Training of Technicians held at the College of Education (Technical), Huddersfield, England, from 17th to 29th October 1966.

A number of important themes were developed during the course of the Conference, but, as was the case with the Commonwealth Conference on the Teaching of Science in Schools held in 1963, no resolutions were passed and no detailed prescriptions for administrative action laid down. The Conference chose to consider the basic principles underlying the education and training of technicians, to provide for a free and frank exchange of information and views, and to leave it to each country to apply these principles in the context of its own circumstances. The main points of emphasis are summarised in Chapter II, and developed more fully in Chapters IV to XII which contain the leading papers presented to the Conference and reports of the discussions which took place both in Working Groups and in plenary sessions.

The Conference, having accepted a broad general concept of the meaning of the term 'technician' in many diverse fields, was much concerned with an examination of the basic need, in the context of the general provision of trained manpower, for adequate provision of personnel at the technician level. It was recognised to be of fundamental importance that each country should assess its own needs, both in the short term and the long term. This was seen as part of the process of adjustment to the rapidly changing economic and sociological environment which is resulting from the progress of science and technology.

A recurring theme was the indispensable role of technicians in the development of agriculture, industry and commerce. In order that proper provision may be made for them within the framework of an educational system, it must be recognised that they have specific needs. It was frequently stressed that the technician was neither a 'failed technologist' nor a 'superior craftsman'. Courses of education and training for various types of technician must therefore have an integrity and a clearly defined purpose of their own.

I know that I speak for all the delegates who attended the Conference when I express the hope that the suggestions made and the material assembled in this report will be of assistance to the Governments and the education authorities of the Commonwealth in planning their programmes for the development of education and training in this important field.

Chapter I of the report includes sincere acknowledgements to those whose co-operation made the Conference possible, and who worked so hard in the endeavour to ensure its success. I must especially mention my personal indebtedness to my colleagues who served on the Organising Committee. This Commiteee was set up by the Commonwealth Education Liaison Committee in May 1965, and, apart from informal meetings of small working groups, met on fourteen occasions. Any success which the Conference may have achieved was, I am sure, due in very large measure to the foresight and wisdom of the decisions taken at these meetings.

I must also pay tribute to the splendid work of the Conference Secretariat headed by Mr. L. M. Graham, the Conference Secretary, with Mr. W. Hobman and Mr. J. M. Scoular as Assistant Secretaries. The delegates were unanimous in their praise of the arrangements made for the administration and documentation of the Conference. Finally, I must mention those who have helped in the editing and publication of this report, in particular Mr. W. G. Sparrow and Mr. B. H. Henson, whose services were kindly made available respectively by the Huddersfield College of Education (Technical) and the City and Guilds of London Institute. Their devotion to this task is deeply appreciated.

I am, Sir,
Yours truly,
G. E. WATTS

Text of the Opening Speech by The Right Honourable Anthony Greenwood, M.P., Minister of Housing and Local Government

First of all let me say how pleased I am to see in this Hall today so many distinguished representatives from the world of technical education and training. I am sure that you are going to have a very stimulating conference and that your work will be of great importance to many Commonwealth countries.

As you all know this Conference is the third in a series of Specialist Conferences which have been convened as a result of recommendations from the Commonwealth Education Conferences and it marks yet another stage in a rapidly growing and most encouraging development in Commonwealth co-operation in the educational field. There are people here from all over the world, representatives of this greatest multiracial association in the history of mankind and all joined together in a close and continuing concern in this vital field of technician education and training.

The problems to be examined by the Conference are world-wide and they have in recent years attracted more and more attention—indeed concern—at all levels of education. Fairly recently, and fairly sharply, shortages of suitably trained technical personnel have begun to appear. Governments, Ministries, industrialists, those concerned with agriculture, have all begun to find their plans for development being slowed down and obstructed by shortages of the vital middle-men—the technicians—the people who make the wheels turn.

This is not then an academic problem; it is a practical one of vital urgency and extreme importance. Without properly trained people, all too often progress is delayed; indeed the injection of new capital into new projects can become an exercise in frustration unless the manpower is there to make use of it; and this can do nothing but harm. But I know here that I am preaching to the converted and I see indeed that the role of technicians in the general manpower and economic picture is one of the subjects which you propose to discuss.

I am glad to see also that in your crowded programme you have taken the deliberate decision to spread your nets as widely as possible examining, for example, the part played by technicians in the fields of agriculture and commerce, as well as the more usual areas of civil, electrical and mechanical engineering and so on. This wide definition of the problem is, I think, vital if we are to see the technician in true perspective. As the complexity of our economies increases, so no doubt will the continued demand for what are in fact technicians in a wide and constantly growing variety of occupations. Thus we must be sure that training in all fields does not lag behind; in this most interdependent of ages a lag in any sector of the economy all too soon shows itself as a lag in the economy as a whole.

As I say, I am glad to see manpower planning and the status of the technician figure as major items in your programme. Some form of planning is now becoming essential in all societies—whether plans for development in developing countries or plans for necessary redeployment of resources in both developed and developing countries. As you know we have in this country some experience ourselves of this latter problem. There has been in fact a great deal of shifting in the industrial base of the United Kingdom over the past twenty years or so, bringing with it many social and labour relations problems as well as the rather more generally recognised financial problems attending the decline of old industries and the rise of new ones. Training and re-training, planning and pre-planning to make the best use of scarce and valuable skilled labour already occupy a growing place in our thoughts in this country. I need hardly stress the great value of such flexible training for developing countries whose resources both of capital and trained manpower are often stretched to the limit by the demands of development.

As part of my preparation for the Conference I received a formidable bundle of documents, and I understand that all delegates are the happy possessors of these documents too. I must say that I am much impressed by the effort which has clearly gone into their preparation, and I should like to congratulate the lead speakers and those member Governments which have contributed papers on the work which they have done. These papers, dealing as they do with widely differing countries in four continents, have much in them that relates specifically to their local environments; but the abiding impression left by them is of a fundamental unity of approach in what are really very similar situations hiding under local disguises. They underline the truly international character of the problems of technician training in all countries, and show, to my mind at least, broad general agreement on how these problems are to be tackled.

I notice from your programme that you will be visiting three colleges in this area—the Askham Bryan Agricultural Institute; the Bradford Technical College and the Huddersfield College of Technology, and that you will also be seeing A.E.I. Ltd. in Manchester. This is an area where educational institutions and industry, with its own training schemes, live close to one another, and it is one of our current aims, through the newly set up Industrial Training Boards, to foster close co-operation between colleges and industry so as to turn out men and women trained not merely in the—dare I say it—slightly rarefied atmosphere of the college laboratories and workshops, but also in the brisk, hurried world of commercial competition helping to make real things which must be sold to real customers. The balance between these two essential elements in the training of a technician is always difficult to assess and, once the ideal ratio is settled, often just as difficult to put into practice. The answer is co-operation between college and industry, and I am confident that in the course of your visits you will see plenty of evidence of this. Speaking as a local man, I am sure that you will find these visits of great interest, and that we shall have a good deal to show you which will have direct bearing on your discussions in this Conference.

The same is true of the exhibition and demonstration of Audio-Visual Aids, which you are to see next Monday. These aids are playing an increasing part in teaching in this country and, used in the correct way by properly trained people, can be of value out of all proportion to their cost. For developing countries they have the additional advantage that they represent a saving of scarce staff, enabling one teacher to meet a much wider audience and often also enabling him to put over his points to his classes more effectively than is possible without the use of the aid. There is obviously an art in this: the aids must be properly used, and their use must be carefully planned. The numbers of aids available and the differences in degrees of sophistication between the simplest and the most complex are such that in every case where an aid might be used, a very careful assessment must be made of the precise needs to be met, the minimum sophistication compatible with the skills of both teachers and taught, and the amount of money which can usefully be spent on the project. The sums involved are often large, and any mistaken policies are correspondingly costly: when both money and time are short, this is a very serious matter. I know that many of you are already using these aids, some of you extensively; but I hope that we will still be able to show you something new and something which you will be able to make use of after the end of this Conference.

And now, a brief word about your rather elegant surroundings. When the British Government arranged with the local education authority for the use of this College for the proceedings of this Conference, it did so because it knew that there was here a modern residential technical teacher-training college—one of four such colleges in the United Kingdom, and representing an attitude to technical teacher-training which would have been regarded as impossibly advanced even a few years ago. The results, however, speak for themselves, as does the fact that there are in the College at the moment a considerable number of Commonwealth students, representing quite a high proportion of the total enrolment of the College. The British Government also knew that in Mr. MacLennan, as Principal of the College, they had a man with wide experience of technical education both in this country and abroad. The Government thought, therefore, that this College would be the most appropriate venue for a Conference such as this, and I hope that at the end of this fortnight you will agree with the British on this point at least.

I hope that what I have said to you so far has succeeded in conveying to you a sense of the importance attached by the United Kingdom Government to technical education and technician training, both at home and overseas. Some of you will already have come into contact with the technical education branch of our Ministry of Overseas Development and with the Council for Technical Education and Training in Overseas Countries—better known as TETOC. The Ministry and TETOC work closely together in day-to-day contact trying to solve the difficult problems of finding staff to fill overseas posts, arranging training programmes for overseas students, contributing on occasions to the finance required for new colleges overseas, and when invited to advise on technical education matters, doing so with a view to the future, and trying always to envisage the likely pattern of development. Let me say here at once that this is already a two-way traffic: every adviser on every trip abroad brings home with him—as well as pleasant memories of his tour!—some new concept of training, some new problem, some new method, applied in local circumstances indeed, but capable in many cases of wider application. Gone are the days when the ideal of every nation was some form of Western-oriented curriculum, devised for small, heavily populated, highly industrialised countries. Much more relevant to many countries nowadays are the experience of countries such as Canada or Australia—large countries with scattered areas of development, and where problems are posed by their very size. We are all, I think, very conscious now of how much the local environment must mould a nation's planning for technical education, and the Ministry of Overseas Development, I venture to think, sees as much of these problems as does anyone.

Finally, I should like to pay warm tribute to the Organisations which have sponsored the setting up of this and the other Specialist Conferences—the Commonwealth Education Liaison Committee and the Commonwealth Education Liaison Unit. These bodies represent all the nations in the Commonwealth and, as I am sure you know, their activities in the field of Commonwealth co-operation in education are many, widespread and fruitful. I hope, indeed I am convinced, that this Conference will turn out to be one of the most important which they have ever staged.

In conclusion, I should like to welcome you, both as a member of the Government and a local lad, to Huddersfield and to its College. May you enjoy this fortnight and may you go from it feeling that there has been yet a little more progress in dealing with this most serious, vital and pressing matter.

Text of the Closing Speech by Mr. Goronwy Roberts, M.P., Minister of State, Department of Education and Science

When my colleague Anthony Greenwood welcomed you on behalf of the British Government on the opening day of the Conference, he expressed the hope that you would depart from it feeling that a little more progress had been made in dealing with this most serious, vital and pressing matter—the education and training of technicians.

From reports I have had from officers of my Department, and above all from everything that Sir Willis Jackson has just had to say, I feel sure that Anthony Greenwood's hopes have been more than fulfilled. You have completed a full and arduous programme. In the course of it you have each been able to make your expert contribution to the wide-ranging discussions. When the full report of the Conference comes to be written up, I venture to suggest that it is likely to be the most valuable corpus of knowledge on the education and training of technicians to be found anywhere in the world at the present time.

This result must, I feel sure, be highly gratifying to all those who have worked so hard for so long to ensure the success of the Conference. Conferences of this kind just do not happen of their own volition. As you all know only too well, a tremendous amount of hard work must go into their planning, organisation and running. I feel, therefore, that it would not be right for me to let this occasion pass without paying my own tribute to the Commonwealth Education Liaison Unit, to Dr. Springer, its Director, to Mr. Graham, his Deputy, and to each and every member of their staff; to the Organising Committee under the Chairmanship of Dr. Watts, to whom we are even further indebted for his able Chairmanship of the Conference itself; to Mr. MacLennan and all the staff, teaching, administrative and domestic, of this very fine College; to the Principals and Directors of the Colleges and other establishments which you visited; and last, but far from least, to the Mayor and Municipality of Huddersfield for the true taste of Yorkshire hospitality which they so freely offered.

The fact that this Conference has taken place at all is indicative of the importance attached to finding solutions—and I stress the plural, because the nature of the solution will depend so much on the background and environment in your respective countries—to this urgent problem which faces all of our countries today, the problem of—and here I quote from Dr. French's comprehensive lead paper—'how to recruit, train and keep up to date the vast and growing army of technicians without which no nation can hope to expand its industrial, business and agricultural interests and its social services'.

This emphasis on the importance of the technician has found an echo in all the papers prepared for the Conference, whatever the country of origin, and not least in those expressing the point of view of developing countries. I was, for example, struck by the following passage from Mr. Chandrakant's extremely thoughtful lead paper—'In the final analysis the pace and direction of the economic progress of developing countries will largely depend upon how far they solve their technician problem'. This and similar statements in other papers reveal the measure of importance attached by the Conference to the *role* of the technician.

I am very glad to know, too, that the Conference attached critical importance to ensuring a proper *status* for the technician. We should have no quarrel with status, only with status symbols. To quote from one of a series of excellent papers contributed by our Australian friends—'The technician is neither a superior tradesman nor a depressed technologist'. It is indeed essential that the technician be accorded a status of his own, that he feel himself to be a member of a body with an ethos of its own, a body of men—and women—who have wanted to become technicians rather than anything else, who have been selected as having the right qualities for a technician, who have had the education and training appropriate to a technician, and who are proud to bear the title of 'technician'.

One certain way of helping to achieve this status is to ensure that the relevant programmes of education and training are 'custom-built' for technicians, deriving neither from craft courses 'plus' nor from technologist courses 'minus'. In the succint words voiced early on in the Conference by a member of the Canadian delegation—'the programmes must have their own integrity'. We must all feel highly gratified that this question of status has found such important expression throughout your deliberations.

The Conference is now over, and I am here on behalf of the British Government to wish you well as you depart for your homes in the four corners of the earth. This I do most earnestly. But I am sure you will all agree with me that this is not the end, but rather the end of the beginning, of the attack which you must now make on the manifold problems facing you in this field. I hope you will feel, as I do, that this Conference has been a successful milestone along the road which lies before you, and that as a result of it you can all see your way ahead at least a little more clearly.

I am sure that all of you will have to face many difficulties in getting your ideas put into practice. I hope that in facing them you will be sustained by the inspiration drawn from your exchanges here, and from the contacts which I am sure will continue between you. I offer you all my good wishes, and those of the Government I represent, in your future attempts to reach the common goal, which is to devise and put into operation the best system possible in your own circumstances for the effective education and training of the technician, whose importance to the economic life of all our countries—and through this to a better life for all our peoples—can scarcely be overestimated.